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The long life of the steel tie has been one of the advantages often emphasized by its advocates. Estimates have ranged from 25 years up and these assumptions have been used in formulae demonstrating the economy of its use as compared with the treated or untreated wooden tie. Mr. Cushing, in an article printed elsewhere in this issue, gives the actual life of steel ties in countries where they have been in service long enough and under sufficiently varying conditions to make it possible to get true mean figures. He finds that the maximum is from 18 to 23 years, while the average is much less. Since it is corrosion and not breakage that limits the life of a properly designed tie, the scrap value of a discarded tie is also less than has been estimated. These results are of immediate value, as we now have good working figures to take the place of assumed ones, and it is to be hoped that Mr. Cushing's request for more detailed data on the service of steel ties in Europe will bring out further information. He concludes that to give 20 years' life under the conditions of traffic in the United States, steel ties must be made heavier than those used in Europe. Since this will increase their first cost, it by so much diminishes the extent of the substitution of steel for wooden ties, particularly if intelligent forest preservation be carried out.

THE RAILROADS OF THE WORLD.

The mileage of railroads in all the different countries of the world at the end of 1906, or the nearest date reported, are given in the *Archiv für Eisenbahnwesen*, and we summarize it as follows for the several continents:

	Miles.		Miles.
Europe	196,414	North America	260,386
Asia	54,655	South America	33,586
Africa	17,519	Australasia	17,716
The Old World	268,588	The New World	311,688

Thus the total mileage of the world is 580,276, a little more than half of which is in America, and 43,100 miles more in the New World than in the Old. The increase in mileage for the last year reported was 17,376 miles, which is greater than in any other year, at least since 1895, the nearest approach to it having been 15,903 miles in 1904. The addition in 1905 was 13,036 miles, so that one-third more was built in 1906. Nearly half of the mileage opened in 1906 was in America, and of the new mileage in America 7,285 miles were in North America and 727 miles in South America.

For the first time in history, more railroad was built in Asia (4,063 miles) than in Europe (3,907 miles), a fact that will doubtless be chronicled many times hereafter; and, notably, China led, with an addition of 1,452 miles, against 1,150 in Russia, 709 miles in Turkey and 371 miles in British India. India still has, however, more than half the railroads of Asia. The 1,118 miles opened in Africa in 1906 form a small extent for so great a continent, but is more than was ever built there before in a single year, and makes an addition of more than 6 per cent. to its total mileage. Both on the east and west coasts railroads are penetrating from numerous points across the sickly low country to the higher interior, several of them toward navigable streams or lakes. In Australia only 275 miles of railroad were opened in 1906. The long drought had impoverished the country.

In our division we have included the Central American states with North America and the West Indies with South America. Of the 727 miles opened in the latter division in 1906, 366 miles were in Argentina, 158 in Brazil and 54 in Chile. In Europe, Russia opened 1,034 miles, Austria-Hungary 814, Germany 558, France 420, Sweden 299. Only in Russia is there room for a great increase in mileage. There and in Asia, and especially in Asia, is the great field for railroad building, and now that the Chinese themselves want railroads, we may expect a very great increase within the next twenty years. The statistics of capital invested in railroads are less complete, though for Europe substantially so. They indicate a total investment for the whole world of about $47,400,000,000, very nearly half of which is in the railroads of Europe, which have but little more than a third of

the total mileage. The average per mile is $115,283 in Europe and $60,131 in the rest of the world. The total increase in this investment in the year was $2,380,000,000. Per inhabitant the total investment is about $31. Although the United States still leads in railroad construction, counting by mileage alone, the time has come here when improvements and additions to the capacity of old railroads require more capital than the construction of new ones. Nowhere is this shown better than in New York City, where the tens of millions which the New York Central is expending will not add to its length, and the Pennsylvania is spending $70,000,000 for what will count in a statement of "length of railroad" for perhaps five miles.

THE DUTY OF THE RAILROAD AGE GAZETTE.

The basis for this undertaking is the fact that the men heretofore employed on the staffs of the *Railroad Gazette* and the *Railway Age* can be more effective, working together in harmony, than working separately in rivalry. The wasteful stimulant of competition is no longer needed. The higher aim, the chance to do more good in the world, is a fine inspiration for earnest, studious work, and it is enough. It is enough because those responsible for the conduct of this paper, and all the workers on it, with its enlarged field and its enlarged facilities, feel their responsibilities so deeply that nothing else can add effectively to the incentive.

There is no thought of monopolizing the field of railroad journalism, but, so far as an experienced body of men can do it, there is a serious purpose to develop by investigation and publicity the science and art of railroad transportation. The subject is great; there is a grand result to be accomplished; and real workers who enter the field are welcome. This science and art includes the improvement of appliances and methods of operation, and involves obtaining the right to serve the people unharassed, but decently controlled by government. These seem to be the two general divisions of the field of usefulness for a railroad journal, and to be of use this publication must be independent, must be quite as ready and zealous in making public injustice by the railroads as it is to correct errors and publish facts which enable newspaper editors and legislators to deal fairly with the most important industry in the land.

"Nine-tenths of the woes of the world come from misinformation." The railroad history of this country is a record of advancing and receding tides of public sentiment; of overconfidence in investment and timid withdrawal; of free and of over-restricted railroad charters; of general government, state, county and village "aid" and of government hostility and persecution. Both high tide and low tide are public calamities, and if the history of civilization teaches us any one thing it is that facility of communication and the dissemination of facts, century by century and decade by decade, lessen the violence and hurtfulness of great upheavals. It is the high purpose of this paper to help with facts and not by preaching.

Emotion will be a force to be reckoned with as long as people are human, and experience teaches us that it is quite as liable to be based on error as on truth. "The Jungle," an imaginative book by Upton Sinclair, shattered the confidence of many countries in the healthfulness of American canned meats, and in a year cost this country more than $25,000,000 in exports. It was a cruel libel, a wicked and far-reaching damage and loss. It is now plain that the possible prevention, or only possible antidote, was quick and clear publicity of all the processes involved. As we have followed carefully during the past two years discussions in the legislatures of more than forty states which have resulted in hostile and expensive laws restricting railroad earning, it has been unusual to find in any speech or public document a calm, judicial statement of facts on which legislation might have been based. It has been the ripened fruit of error.

The relation of the community to the railroad cannot safely be neglected until public sentiment makes itself felt in the legislature. It is then too late. The people's forum is the daily and weekly newspaper. The day is long past when the editor's editorials made opinions for his readers, but the day is present when his facts, or his untruths, make those opinions. He will print clear, fair and convincing studies of the basis of rates, the causes of accidents, of appliances for safety and economy, the traffic department's undertakings to develop country—all those wonderful works by which railroad men make their tributary region rich in order to create transportation. These things still the voice of the slanderer and make futile the activities of the legislative striker. It is clearly the plain duty of a railroad paper to study out and furnish this information and to be recognized as being fair because it is fair.

In addition to this public duty, for the betterment of the state as well as the railroads, the railroad paper should be able to give the railroad officer in each department news and knowledge of the experience of others of a kind to help him in his special work. It is an attempt to give him every week a knowledge of others' appliances and methods quite like that which the members of the American Railway Association, the Master Mechanics and Master Car Builders' associations, the civil, mechanical and signal engineers and other railroad clubs and associations get from each other at their less frequent meetings. Whether or not those who have now joined their forces in this new weekly railroad paper have in the past been helpful to the railroad officers, the readers are well qualified to judge. In this work the improvement should be marked.

It is commonly considered pardonable in an announcement of this character (although it will be read by only a few of the readers of this paper) to recall some of the instances in the past where the decision of great questions has been influenced by the facts here studied out and made public. Nearly forty years ago the delusive theory that a 3-ft. gage railroad should cost three-fifths of a standard-gage railroad, for building and working, was a successful catch-penny among all classes of investors. The Denver & Rio Grande built a thousand miles, successfully, but with a comparative heavy loss, for the main line had to be wholly rebuilt. Most of the other projects, and they were many, meant ruin from the beginning. The *Railroad Gazette*, supported by a very few eminent engineers, but entirely alone among publications, successfully met this madness by persistently and judicially proving the error. In the period following 1893, when the location of the Isthmian canal was settled, the same paper, with the aid of some of the ablest engineers in the world, was credited by the best informed people, with preventing the adoption of the Nicaragua route. It is perhaps fair to mention one name here. Colonel Prout was a pioneer in this debate, and it is one of his credits that he helped to save his country from a wasteful mistake. The adoption of standard threads for bolts and nuts, a limiting condition in the repair of cars on foreign roads, was initiated and carried through, with magnificent support, by the editors of this paper.

The record in recent years of both of the publications here combined has been conservative and helpful in the solution of railroad engineering and economic problems, and in influence with the daily newspapers. The present editors feel no lack of modesty in saying this much, for they have been guided and encouraged by frequent conference and correspondence with able officers in all departments. In the beginning of the discussion of the Hepburn revision of the Interstate Commerce law, it seemed wise to meet the issue squarely on this basis of principle: Government has the right to control. Instead of combating bad control, suggest and ask for that control which is best for the whole people. We were severely criticised, as well as cordially supported, but our

press clipping service shows that the facts and the point of view of this paper on the Hepburn bill, were more widely quoted in the newspapers of the country than were those of any other publication. The same thing has been true of our discussions of labor relations and of the general effect of legislation on industry, because we were not an organ, for somebody to play on, but a critical newspaper. The result is hopeful, but there are to be years of work. The railroad papers have also been enabled to do good work in getting better rails—because any one railroad was nearly helpless. But, anything like a complete list of the duties of a railroad paper, aside from its weekly special news, would be tiresome.

There is no personal vanity involved in a confident belief that the *Railroad Age Gazette* will be a factor in improving the art of railroad transportation, and in creating a right relation between government and the corporations.

THREE YEARS' PROGRESS IN SIGNALING.

In a five-year review of American practice in railroad signaling, made on the occasion of the meeting of the International Railway Congress at Washington three years ago (May 19, 1905, page 548), we ventured a few easy predictions; and these have come to pass. The remarkable activity which has characterized these three years warrants another review now. The increase in automatic block signal mileage would have been great, even without the phenomenal expenditures of the Union and Southern Pacific; and the stimulus to the manufacturing end of the business by the electrification of important railroads and by the demand for improved details in all directions, has resulted in marked scientific progress. Power interlocking has not, perhaps, made the wholly unhindered progress that was expected by many, but it has taken no backward step.

Taking up the subject in detail, the first thing is automatic block signaling. Considered from the standpoint of its effect on the economy, efficiency and safety of operation, the increasing use of automatic block signaling has been the most important development in the art. This is not merely because the extended use of automatic block signals has added to safety of operation, or because it has reduced the cost of operation by the saving of wages and prevention of accidents, especially to freight trains, but because it has also enabled a unit of track to accommodate a denser traffic, thus saving in several important ways; for example, by postponing the necessity of providing additional main tracks. This development in the use of automatic block signals has occurred not only on double-track railroads, but also on single-track lines. In this latter particular, the Southern Pacific, Union Pacific and allied lines have gone far in advance of the rest of the world. The Delaware & Hudson has installed a large number of automatic block signals on its single track lines also and an installation on the Ulster & Delaware is notable, by reason of the completeness of its details. As evidence of the increasing demand for automatic block signals there are four new types of mechanism on the market, made respectively by the American Railway Signal Company, the Federal Signal Company, the Continental Signal Company and the McClintock Manufacturing Company. All these are operated by electric motors. Electro-pneumatic signals maintain their popularity on the four-track lines where they have long been in use, but the electro-gas signal does not now meet with the favor it enjoyed at first.

Improvement in automatic block signals cannot be said to have been radical. It has been confined to details of design. An important step, however, has been taken in the use of storage batteries for the operation and control of such signals. This is said to be resulting in a saving in the cost of operation on many roads, as well as in maintenance, and in greater reliability. The relative merits of portable storage batteries, charged at a central station and distributed to the various signal locations, and, on the other hand, of storage batteries charged in place from power lines, have been the subject of considerable discussion. The former practice prevails in the West, with its long distances, while the latter is confined to the roads of denser traffic in the East. The different conditions largely account for the differing views.

Considering the matter from the standpoint of the signal engineer alone, it would probably be true to say that the most important development in the art of signaling has been the employment of alternating current track circuits for the control of signals on electrically operated railroads. It is just about five years ago that the pioneer installation of this arrangement went into service on the North Shore Railroad in California. This was quickly followed by the important, and indeed daring, installation in the New York subways. The confidence of the engineers and of the responsible officers of the Interborough Rapid Transit Company has been fully justified by the unprecedented efficiency of that installation. This was followed by the signaling of electrified lines on the Long Island Railroad, the West Jersey & Seashore, the New York Central, the New York, New Haven & Hartford, the Philadelphia Rapid Transit and the Hudson & Manhattan. An important advance in economy and simplicity in this line not yet in service, except experimentally, is the development, by the Hall Signal Company, of a system of alternating current track circuits, requiring neither insulated rail joints nor impedance bonds.

A further advance in line with the inevitable course of electrical engineering is the signaling of roads where alternating current is used for propulsion. An installation designed to meet these requirements is now in operation on the New York, New Haven & Hartford, from Vernon to East Hartford; although direct current is still used there for the propulsion of trains. The obvious development in this direction is to work the signals, control them and light them by alternating current supplied from the power mains. This does away with batteries and with the necessity for two kinds of apparatus, thereby effecting marked economy in maintenance and operation. The installations on the New York Central, the Hudson & Manhattan and the New York, New Haven & Hartford, as above, are examples of this economy already in effect. Another step in advance has been the elimination of moving parts from tunnel signals and the substitution of colored glasses illuminated by electric lamps controlled by relays direct, without intermediate electro-magnets. One notable installation, however, that on the Hudson & Manhattan, employs a moving disk to obscure or display the colored lights; but in this case the mechanism and relay have been combined.

The overlap seems to have become a permanent feature of automatic block signaling on roads of dense traffic. Overlaps one block long are in use on the New York subway, the Long Island Railroad, the Philadelphia subway and on the New York Central electrified lines. On the Hudson & Manhattan the overlaps are two blocks long; and another installation, now being put in, will have a six-block overlap. The overlap, theoretically, is inconsistent with good discipline; but the city railroads where it is being used have such a very dense traffic that the men responsible for the safety of the trains evidently feel, with Grover Cleveland, that trying conditions, actually confronting them, may justify them in paying scant respect to theory. The economy of the overlap is a serious question yet to be settled.

Polyphase track and control relays are coming into use more and more, as it is possible with them to operate longer track circuits than with single phase relays. Such relays can also move efficiently and safely a much larger number of contacts than single-phase relays.

The use of the telegraph block system has also been greatly extended during the past five years. Controlled manual, however, has made no progress except on single track lines.

Notable examples of controlled manual block signaling without track circuits may be seen on the Illinois Central and the Burlington. Another important installation of controlled manual (electric train staff), is in service on the Southern Pacific in the Sierra Nevada mountains, where 110 miles of line are worked by this system. Signal engineers are now generally agreed that the "controlled manual" system should always have the track circuit through the whole length of each block. Such signals are being installed in increasing numbers on single track lines, notably on short sections, or "throats" between sections of double track. Two new arrangements of circuits and apparatus for this purpose have been devised, one by C. C. Anthony and one by the Hall Signal Company. The use of the "lock-and-block" on other than single track roads has decreased, being superseded by automatic signals. The New York Central and the Long Island railroads, while continuing to use the "lock and block," have constantly extended their track circuits until, through the employment of semi-automatic signals, the lock-and-block feature is rendered nearly superfluous.

The most notable progress in power interlocking has been in connection with the electrified lines of the New York Central, the "all-electric." There are on the market two new designs of electric interlocking, one made by the American Railway Signal Company and the other by the Federal Signal Company. The Union Switch & Signal Company has introduced a number of improvements in its electric interlocking apparatus. The General Railway Signal Company has made new designs of switch movements and of signals to meet the conditions of limited clearance in the New York Central Electric Zone. It has also made important changes in the indication circuits. No radical changes have been made in electro-pneumatic interlocking and no new "all-air" plants have been installed in this country during the past two years.

No marked improvements have been made in mechanical interlocking. In this field all efforts have been directed toward standardization of parts and refinement of detail. Wire is coming more and more into disfavor as an operating medium and it is common now to work dwarf signals by pipe. High signals are now frequently power-operated, and evidently such signals will be installed in increasing numbers at mechanical plants, especially where it is necessary to set the signal more than 500 ft. from the cabin. Such signals can be made of the same type as automatic signals used in the same territory, thus securing uniformity of apparatus, and it is a great advantage to be able to set them at any desired point, no matter how far away, as is practicable, of course, with a signal controlled by the electric current. Iron and concrete are steadily displacing wood for foundations and iron tubes are being used everywhere for signal posts.

The semi-automatic control of signals at large interlocking plants, as may be seen on an important scale at the Washington Terminal and at the Broad Street Terminal of the Pennsylvania at Philadelphia, is another significant step in advance.

The use of electric locking to perform the function of the detector bar has increased rapidly. There has been marked improvement both in apparatus and circuits. The point at which the locking takes effect has been constantly extended beyond (in the rear of) the distant signal. Coincident with the adoption of electric locking has come improvement in indicating devices. Illuminated indicators showing the condition of track sections by colored electric lights behind track diagrams, or electric lights below the lever handles of interlocking machines, are now in use, greatly facilitating the work of the levermen at busy cabins.

There is a tendency to increase the number of contacts on relays. Not very long ago two contacts were considered the maximum that could be operated by a track relay and four by a secondary relay. There are now track relays on the market with six contacts, and they give satisfactory service; and secondary relays with eighteen contacts have been designed by one company. Improvement in accessories such as switch and cabin indicators and electric lever and switch locks has kept pace with the development of other signal apparatus. Tower and cabin indicators operated by alternating current and having a large number of relay contacts are now in use where such current is used to operate the signals. Both the older and newer signal companies have recently introduced new designs of switch locks which overcome to a marked degree the faults that have, in the past, prevented a more widespread adoption of this device.

The introduction of automatic train stops in certain special installations should be taken into account. This was done on the Boston Elevated more than five years ago, but the largest use of automatic stops ever made in America is in the New York subways. They are also used on the Philadelphia subway and the Hudson & Manhattan. They are still confined to roads which, like those named, have a dense traffic. The London underground and "tube" lines now have about 1,000 signals which are equipped or soon will be equipped with automatic stops.

The Railway Signal Association and the Railway Engineering and Maintenance of Way Association have recently taken action which may prove more far-reaching, as an element in progress toward perfection, than all the other things here mentioned; we mean the adoption of a plan for a uniform system of signaling at the Milwaukee meeting last October. This plan provides distinctive and consistent indications for all the information that it is necessary to convey to an engineman by fixed signals. Largely by the influence of these two associations, the use of semaphore signals which give their indications in the upper quadrant is becoming popular. Such signals are now in use, both for block signaling and interlocking on several roads, notably the Pennsylvania, the Baltimore & Ohio, the Rock Island, the Lake Shore and the Great Northern.

Signal engineers are coming more and more to demand of both block signals and interlocking that they shall give complete protection. The railroad officer who, to reduce initial expenditures, is willing to put up with makeshift signaling is not nearly so influential as he was a few years ago. It is customary now to signal every possible route through an interlocking plant and to provide separate distant signals for the home and advance signals. It is not unusual to find two distant arms on the same post approaching an interlocking plant, one for each of two high speed diverging routes. Examples may be seen on the New York Central and the Pennsylvania. The last-named road has perhaps more than any other insisted on completeness and consistency in signaling.

Lastly, one of the most significent signaling developments of the past three years has been the development of the profession. The Railway Signal Association now does good work constantly, and is growing in influence. Its committee work is of great value to the railroads and they can well afford to give it substantial financial support—if only the association officers will see that that work is done *in committee*, and not in the full meetings!

NEW PUBLICATIONS.

Practical Earthwork Tables. By C. E. Housden, Superintending Engineer, P. W. D. India. London and New York: Longmans, Green & Co. 49 pages, 4⅜ x 7 in.; 9 illustrations. Cloth.

The author announces in his preface that these tables have been "prepared with a view to reducing work necessary in the preparation of estimates for roads, railroads, etc.," and that they have been gotten out on novel lines which should secure them approbation from the resulting simplicity. Unfortunately the principles of the novel arrangement are not clearly explained. At the opening of the book the author sets forth the formula by which the triangular portion of a fill or cut can be computed. By the triangular portions are meant the parts bounded by the slope, a vertical from the side of

the roadway or bed and the original surface of the ground. This is very clear and is one with which all engineers are familiar, but when he applies it to the tables the latter are encumbered with reference letters for which there is no explanation in the text, with the result that the prospective user must go through all of the calculations needed in order to ascertain the meaning of these obscure symbols. Of course it is not at all probable that the busy man who wishes to use a set of tables for a short cut will take the time to work them out and prove them to see what they mean. It would take longer than to work out the immediate problem in hand by the ordinary methods. If, therefore, these tables are to be made to fulfill the purpose for which they have been calculated they should be preceded by such clear and minute instructions that he who runs may read and be able to make the application easily. Even in the chapter that is supposed to explain the application of the tables, instead of working from them and showing their application to the solution of problems, an example is given and then worked out from the formula in all of its elaboration in a manner that anyone could do without the slightest reference to the tables themselves. The result is that though the work has been carefully done and there may be some saving in time by the use of the tables by one who is as conversant with them as the author, the presentation is so obscure and involves so much for the proper understanding of their manipulation that there seems to be little or no chance of their ever being extensively used.

LETTERS TO THE EDITOR

The Pennsylvania Rail Sections.

Crafton Station, Pittsburgh, Pa., May 28, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

My communication in the *Railroad Gazette* of December 6, 1907, asking some questions relative to rolling and cooling large rail sections applies also to the rail designs proposed by the Pennsylvania Railroad and published in your issue of April 17, 1908.

Seemingly the Pennsylvania sections are designed with a view to equalizing the internal strains between the head and base of the rail, but will the rolling and cooling of this shape of rail eliminate crystallization in the head and structural strains in the base? No doubt equalized cooling is beneficial, so far as acquiring sectional accuracy, but so far as acquiring proper structure is concerned, it will be ineffectual. Uniform internal structure is obtained by equal elongation of metal in the head and base of the rail, accompanied regularly by equal lowering in temperature; not by equal falling of temperature with *unequal* extension (metal flow) of the different parts.

The mere matter of increasing the thickness of the flange will not obviate longitudinal tensions at the base of the rail nor will it assure equal elongation of the metal, which is of equal importance if uniformity of structure is desired. The desired results can be accomplished by rolls acting on a suitable form of metal at the base of the rail, as is the case in rolling a double-head rail. Homogeneity of structure can be obtained by uniformly elongating the metal in the head and base of the rail with a uniform reduction in temperature. A physical condition of this kind is favorable for more roll passes to get certain characteristics at finishing, thus remedying some faults due to wrong chemical composition.

Aside from physical difficulties, there is a mechanical one which will make the metal more difficult to control in the rail passes; that is, decreasing the radius of head and web. However, in designing the rails in question the railroad man seems to ignore the fact that the rail manufacturer has at least a hundred and one sets of rolls on hand to be either altered or abandoned altogether. On the other hand, a rail of good quality might be made in a design which will utilize the rolls on hand and at the same time produce a rail which will mate with the present A. S. C. E. sections. These features are not evident in any of the proposed designs, outside of the Heinle flat-bottomed double-head rail, which will mate with the present standards and also permit the use of the rolls now used at the mills. Rolls used for the 90-lb. A. S. C. E. section may be used for some of the passes on the Heinle 100-lb. section, and 100-lb. A. S. C. E. rolls for Heinle 110-lb. rails.

A. W. HEINLE,
Consulting Roll Turner.

Cost, Financial Results and Public Service of Railroads.

Richmond, Va., May 28, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

I give below comparative statistics of railroads for 1906 and 1901, as published by the Interstate Commerce Commission. This statement shows an increase in the average density of traffic of 29.19 per cent. in the freight tonnage, and of 27.65 per cent. in the passenger travel; with an increase of only 7.06 per cent. in the revenue train mileage, per mile of road per annum.

Notwithstanding the small increase in revenue train mileage as compared with the increase in traffic, operating expenses increased 31.19 per cent., to which there was added additional interest on an increase of 4.94 per cent. in the cost of property employed in the service of the public; while the earnings from operation increased only 28.72 per cent. per mile of road per annum.

For many years the railroads have been increasing their average train loads to reduce the cost of transporting freight, and thereby compensate for the steady reductions in average rates per ton-mile; but it looks now as if the additions to cost of operation, interest on additional cost of road and equipment, by which the heavier train loads have been attained, were neutralizing the economic effect of them, which was for a time so pronounced as to encourage further efforts in that direction.

Cost of Road and Equipment, per mile of road operated.

	1906.	1901.	Increase.
Cost of road	$51,652.52	$49,729.63	3.86
" " equipment	3,705.45	3,024.53	22.51
" " road and equipment	55,357.97	52,754.16	4.94

Financial Results of Operation, per mile of road operated.

	1906.	1901.	Increase.
Earnings from operation	$10,455.89	$8,122.88	28.72
Operating expenses	6,912.28	5,268.91	31.19
Income from operation	3,543.61	2,853.97	24.16
Deductions from income	2,969.58	2,538.14	17.00
Net income from operation	578.53	315.83	83.18
Income from other sources	1,154.27	919.14	25.58
Total net income	$1,701.80	$1,234.97	37.80

Public Service of Railroads, per mile of road operated.

	1906.	1901.	Increase.
Passenger train mileage	2,135	1,953	9.32
Freight train mileage	2,648	2,494	6.17
Other revenue train mileage	146	157	7.53
Total revenue train mileage	4,929	4,604	7.06
Freight car mileage	75,496	66,344	13.79
Tons of freight carried 1 mile	982,401	760,414	29.19
Passengers carried 1 mile	114,529	89,721	27.65

Train and Car Units.

	1906.	1901.	Increase.
Average passengers per train	49	42	16.66
" tons of freight	344.39	281.26	22.45
" " " " per car	13.01	11.46	13.52

T. M. R. TALCOTT,
General Manager Tidewater & Western Railroad.

Comparative Summary of Freight Cars in Service on the Railroads of the United States.

In the *Railroad Gazette* of May 17, 1907, a comparative statement of freight cars in service on the railroads of the United States was given, covering the years 1905 and 1906. This year, by courtesy of the Delaware & Hudson Company, we are enabled to print two tables, one covering 1900 and 1906, the other 1900 and 1907. The 64 roads considered are divided into five groups as previously: New England roads, trunk line roads, southern classification, central classification and western classification. No attempt has been made to distinguish between the roads reporting operations for the fiscal year ending June 30 and roads reporting operations for the calendar year ending December 31, as it is not believed that the overlap between the two periods affects the value of the figure for comparative purposes. It should be noted also that the comparative group averages are not weighted, although

COMPARATIVE SUMMARY OF FREIGHT CARS IN SERVICE ON RAILROADS OF THE UNITED STATES—1900 AND 1906.

(NOTE.—Narrow-gage cars excluded. Non-revenue cars excluded. Company freight included.)

	Miles.		Freight equipment.		Increase.	Per cent. of ch'nge.	Freight cars per mile of road.		Average length of haul.		Freight cars Per 1,000 freight-car miles.		Freight cars Per 1,000 rev'nue-ton miles.		Rate per ton-mile dollars.		Frt cars per $1,000 freight earn'gs.	
New England Roads.	1900.	1906.	1900.	1906.			1900.	1906.	1900.	1906.	1900.	1906.	1900.	1906.	1900.	1906.	1900.	1906
Boston & Maine	1,787	2,288	12,230	17,936	5,706	46.6	6.8	7.8	66.99	89.16	.126	.088	.0146	.0088	.01440	.01186	1.02	0.75
Central Vermont	513	536	2,006	2,660	654	32.7	3.9	4.9	94.97	84.66	.063	.082	.0079	.0094	.00880	.00919	0.90	1.03
Maine Central	816	816	3,586	5,773	2,187	60.9	4.4	7.0	81.11	87.68	.163	.137	.0123	.0128	.01130	.01032	1.09	1.24
N. Y., N. H. & Hartford	2,008	2,057	13,116	19,264	6,148	46.8	6.5	9.3	85.36	93.22	.076	.095	.0097	.0102	.01451	.01442	0.67	0.71
Total	5,124	5,697	30,938	45,633	14,695	47.5	6.0	8.0	82.11	88.68	.107	.101	.0112	.0103	.01225	.01145	0.92	0.93
Trunk Line Roads.																		
Baltimore & Ohio	3,199	4,030	61,708	80,673	18,965	30.7	19.3	20.0	194.81	193.73	.128	.109	.0068	.0075	.00412	.00550	1.96	1.34
Buf., Roch. & Pitts....	472	568	8,858	12,697	3,839	43.3	18.7	22.3	136.16	148.24	.139	.174	.0097	.0102	.00470	.00508	1.99	2.01
Central of New Jersey.	639	610	15,002	19,005	4,003	26.7	23.4	31.1	77.88	75.61	.153	.150	.0118	.0099	.00871	.00839	1.36	1.18
Chesapeake & Ohio ...	1,476	1,794	17,270	27,212	9,942	57.5	21.6	15.2	302.00	282.00	.082	.102	.0058	.0059	.00343	.00419	1.71	1.40
Delaware & Hudson ...	665	843	13,030	13,783	753	5.7	19.6	16.3	94.46	117.90	.147	.108	.0113	.0064	.00789	.00636	1.54	1.01
Del., Lack. & Western..	947	957	27,287	26,593	*694	2.9	28.8	27.8	151.00	165.00	....	.115	.0144	.0089	.00808	.00780	1.79	1.10
Erie	2,104	2,151	46,225	52,825	6,600	14.3	21.9	24.6	191.40	163.51	.101	.115	.0089	.0088	.00559	.00598	1.60	1.48
Lehigh Valley	1,382	1,445	34,954	36,792	1,838	5.2	25.3	25.5	188.08	169.85	.135	.117	.0106	.0085	.00542	.00626	1.97	1.35
N. Y. C. & H. R.	2,817	3,784	59,180	68,229	9,049	15.2	21.1	18.0	163.00	190.00	....	.089	.0088	.0071	.00560	.00571	1.72	1.24
Pennsylvania Railroad.	3,716	3,897	80,385	119,036	38,651	48.0	21.6	30.5	109.54	156.02	.091	.104	.0067	.0064	.00540	.00595	1.25	1.08
Reading	1,000	1,000	31,824	40,708	8,884	27.9	31.8	40.7	89.42	91.81	.139	.143	.0114	.0093	.00831	.00744	1.50	1.25
Western Maryland	279	540	691	5,920	5,229	756.7	2.5	11.0	51.02	92.10	....	.113	.0038	.0119	.00734	.00730	0.53	1.64
Total	18,696	21,619	396,414	503,473	107,059	27.0	21.2	23.2	145.73	153.81	.093	.121	.0092	.0094	.00622	.00633	1.56	1.34
Southern Classification.																		
Atlantic Coast Line....	1,759	4,334	5,378	17,850	12,472	231.8	3.6	4.1	121.90	143.16	....	.100	.0143	.0133	.01401	.01292	1.02	1.03
Central of Georgia.....	1,196	1,878	5,041	9,047	4,006	79.4	4.2	4.8	148.86	149.94	.107	.124	.0183	.0130	.01096	.00885	1.26	1.17
Louisville & Nashville..	3,007	4,131	23,402	36,633	13,231	56.5	7.7	8.9	163.00	159.88	.096	.114	.0090	.0093	.00758	.00803	1.13	1.16
Mobile & Ohio	876	926	5,389	10,014	4,625	85.8	6.2	10.8	195.63	234.93	....	.113	.0076	.0090	.00590	.00639	1.33	1.41
Nash., Chat. & St. Louis	1,189	1,226	5,328	9,080	3,752	70.4	4.4	7.4	151.00	161.22	.113	.111	.0096	.0100	.00880	.00897	1.10	1.12
Norfolk & Western	1,551	1,853	18,656	31,017	12,361	66.2	12.0	16.7	253.41	260.11	.085	.100	.0068	.0062	.00430	.00460	1.58	1.28
Seaboard Air Line . (1901)	2,604	2,611	8,335	9,860	1,525	18.3	3.2	3.8	153.32	158.55	.119	.098	.0136	.0103	.01180	.01121	1.14	0.92
Southern Railway	6,306	7,374	26,814	47,118	20,304	75.7	4.2	6.4	168.82	157.92	.107	.129	.0116	.0105	.00916	.00832	1.27	1.26
Total	18,488	24,333	98,343	170,619	72,276	73.4	5.3	7.0	169.49	178.21	.105	.111	.0114	.0102	.00906	.00865	1.23	1.17
Central Classification.																		
Chic., Ind. & Louisville.	546	600	5,440	5,728	288	5.3	9.9	9.5	153.00	153.00	.155	.134	.0141	.0109	.00757	.00790	1.96	1.37
Cin., Ham. & Dayton..	652	1,038	7,838	13,770	5,932	75.6	12.0	13.3	108.96	115.86	....	.201	.0122	.0136	.00610	.00592	2.00	2.30
C., C., C. & St. Louis...	1,891	1,983	15,484	23,574	8,090	5.2	8.2	11.9	169.30	152.60	.094	.116	.0083	.0085	.00583	.00566	1.42	1.50
Grand Rapids & Ind....	582	579	3,015	3,225	210	6.9	5.2	5.6	90.12	102.20	.140	.102	.0156	.0076	.00870	.00704	1.88	1.08
Lake Erie & Western...	725	886	5,549	4,603	*946	17.1	7.6	5.2	153.51	140.07	.137	.100	.0110	.0075	.00614	.00637	1.89	1.15
Lake Shore & Mich. S..	1,411	1,520	19,958	35,167	15,209	76.2	14.1	23.1	178.00	159.00	.067	.090	.0055	.0059	.00505	.00500	1.09	1.18
Michigan Central	1,635	1,745	14,219	18,600	4,381	30.8	8.6	10.7	193.50	173.00	....	.075	.0070	.0059	.00592	.00612	1.19	1.00
N. Y., Chic. & St. Louis	513	523	6,743	7,827	1,084	16.0	13.1	15.0	297.00	210.00	.059	.058	.0055	.0048	.00478	.00513	1.16	0.94
Pennsylvania Company.	1,396	1,411	43,967	50,090	6,123	13.9	31.5	35.5	77.95	73.59	.177	.144	.0135	.0083	.00590	.00603	2.30	1.38
Pitts., C., C. & St. L...	1,407	1,429	12,884	22,942	10,058	78.0	9.1	16.0	111.14	97.64	.056	.076	.0052	.0060	.00620	.00655	0.84	0.91
Pere Marquette	1,821	2,333	7,944	17,124	9,183	115.5	4.3	7.3	112.64	170.86	....	.136	.0124	.0098	.00802	.00550	1.55	1.78
Vandalia	727	828	5,922	7,441	1,519	25.7	8.1	9.0	77.46	103.84	.121	.112	.0119	.0087	.00718	.00696	1.66	1.24
Total	13,306	14.875	148,963	210,094	61,131	41.0	11.2	14.1	143.63	137.64	.112	.112	.0102	.0081	.00645	.00618	1.57	1.32
Western Classification.																		
Atch., Top. & Santa Fe.	7,426	9,189	27,486	42,134	14,648	53.3	3.7	4.6	349.19	393.93	.073	.075	.0079	.0071	.00976	.00956	0.81	0.75
Chicago & Alton	855	970	9,386	9,737	351	3.7	10.9	10.0	176.16	172.43	.135	.108	.0148	.0083	.00794	.00638	1.87	1.30
Chic. & Eastern Ill....	711	948	8,206	17,949	9,743	118.7	11.5	18.9	144,70	152.06	.132	.174	.0096	.0104	.00483	.00467	1.99	2.23
Chic. & Northwestern..	5,219	7,454	40,846	54,911	14,065	34.4	7.8	7.4	151.30	144.07	.108	.140	.0106	.0106	.00830	.00888	1.28	1.20
Chic., Burl. & Quincy..	7,546	8,927	42,287	50,360	8,073	19.1	5.6	5.6	254.87	241.51	....	.093	.0111	.0069	.00851	.00698	1.29	0.98
Chic. Great Western...	930	818	5,782	7,317	1,535	26.5	6.2	8.9	301.68	265.17	.087	.086	.0081	.0084	.00720	.00687	1.13	1.22
Chic., Mil. & St. Paul..	6,423	7,187	35,740	39,821	4,081	11.4	5.6	5.6	189.07	177.99	.093	.087	.0106	.0085	.00929	.00861	1.14	0.99
Chic., Rock Isld & Pac.	3,647	7,218	17,150	37,862	20,712	120.1	4.7	5.2	213.00	220.66	.094	.106	.0096	.0088	.00990	.00807	1.08	1.09
Chic., St. P., M. & Om..	1,557	1,711	10,253	11,887	1,634	15.9	6.6	6.9	160.55	146.07	.149	.142	.0135	.0126	.00971	.00931	1.39	1.36
Colo. & Southern	762	1,858	2,979	7,058	4,079	136.9	3.9	3.8	101.00	134.00	.108	.109	.0115	.0077	.01242	.00938	0.93	0.82
Denver & Rio Grande..	1,674	2,177	8,359	10,159	1,800	21.5	4.9	4.7	.....	126.28	.118	.110	.....	.0094	......	.01293	1.09	0.73
Dul., S. S. & Atlantic..	585	591	2,697	2,842	145	5.4	4.6	4.8	49.07	69.23	....	.167	.0209	.0125	.01221	.00855	1.71	1.46
Great Northern	5,418	6,109	21,484	33,196	11,712	54.5	3.9	5.4	192.00	253,04	.104	.096	.0085	.0060	.00899	.00719	0.93	0.84
Illinois Central	3,996	4,424	32,439	55,575	23,136	71.3	8.1	12.5	213.83	242,99	.092	.116	.0094	.0089	.00651	.00555	1.45	1.60
Iowa Central	510	558	2,238	3,024	786	35.5	4.4	5.4	152.30	172,48	.099	.105	.0084	.0072	.00696	.00565	1.21	1.27
Kan. City Southern ...	833	827	5,118	6,918	1,800	35.1	6.1	8.4	304.41	270.73	.118	.111	.0091	.0070	.00613	.00599	1.49	1.16
Minn. & St. Louis	597	799	3,066	3,199	133	4.3	5.1	4.0	108.79	93.52	.196	.160	.0155	.0129	.01212	.01033	1.45	1.25
Minn., St. P. & S. S. M.	1,255	2,282	6,631	11,912	5,281	79.6	5.3	5.2	194.65	222.50	.129	.137	.0109	.0093	.00658	.00664	1.67	1.40
Missouri Pacific	4,938	6,276	25,186	38,977	13,791	54.7	5.1	6.2	236.24	222.12	.102	.122	.0095	.0084	.00834	.00705	1.15	1.20
Mo., Kan. & Texas.....	2,218	3,043	9,669	16,824	7,155	73.9	4.4	5.5	298.93	240.13	.073	.111	.0082	.0120	.00840	.01068	0.98	1.12
Northern Pacific	5,006	5,429	23,138	36,097	12,959	56.0	4.6	6.6	309.60	341.60	.105	.087	.0104	.0069	.00987	.00839	1.04	0.82
St. Louis & San Fran..	†1,659	5,069	5,974	24,286	18,312	306.5	3.6	4.8	182.05	159.30	.093	.120	.0114	.0093	.01058	.00843	1.08	1.10
St. L. & Southwestern..	1,258	1,452	5,386	9,723	4,337	80.5	4.3	6.7	196.28	239.29	.127	.165	.0130	.0142	.01110	.00980	1.17	1.45
San Antonio & A. P....	687	724	1,553	1,702	149	3.6	2.3	2.3	162.26	156.19	.113	.099	.0142	.0108	.01861	.01478	0.95	0.73
Southern Pacific	7,576	9,459	29,413	42,903	13,490	45.8	3.0	4.5	307.31	262.31	.096	.084	.0062	.0059	.00957	.01025	0.73	0.67
Texas & Pacific	1,570	1,848	6,263	8,656	2,393	22.2	3.9	4.9	231.77	203.04	.079	.089	.0093	.0090	.01030	.01030	0.91	0.87
Union Pacific	5,428	5,404	21,826	23,254	1,428	6.5	4.0	4.3	305.69	410.00	.080	.057	.0082	.0035	.01046	.00753	0.78	0.47
Wabash	2,340	2,514	13,087	18,081	4,994	38.1	5.6	7.2	216.70	228.46	.071	.075	.0068	.0058	.00558	.00515	1.23	1.12
Wisconsin Central	950	1,018	7,968	8,309	341	5.5	8.4	8.2	143.16	185.12	.202	.167	.0139	.0103	.00731	.00661	1.91	1.56
Total	83,574	106,283	431,610	634,673	203,063	47.0	5.1	5.9	208.81	211.93	.109	.114	.0107	.0089	.00919	.00829	1.23	1.13
Total all roads..	139,188	172,807	1,106,268	1,564,492	458,224	41.4	7.9	9.0	171.92	175.25	.106	.114	.0104	.0091	.00829	.00789	1.33	1.19

*Decrease. †Before consolidation with other companies.

COMPARATIVE SUMMARY OF FREIGHT CARS IN SERVICE ON RAILROADS OF THE UNITED STATES—1906 AND 1907.

(NOTE.—Narrow-gage cars excluded. Non-revenue cars excluded. Company freight included.)

	Miles.		Freight equipment.		In-crease.	Per cent. of ch'nge.	Freight cars per mile of road.		Average length of haul.		Freight cars—Per 1,000 freight-car miles.		Freight cars—Per 1,000 rev'nue-ton miles.		Rate per ton-mile dollars.		Frt cars per $1,000 freight earn'gs.	
New England Roads.	1906.	1907.	1906.	1907.			1906.	1907.	1906.	1907.	1906.	1907.	1906.	1907.	1906.	1907.	1906.	1907
Boston & Maine	2,288	2,288	17,936	20,376	2,440	13.6	7.8	8.8	89.16	98.74	.088	.098	.0088	.0088	.01186	.01097	0.75	0.80
Central Vermont	536	536	2,660	3,983	323	12.1	4.9	5.5	84.66	79.28	.082	.105	.0094	.0113	.00919	.00947	1.03	1.19
Maine Central	816	845	[illegible]773	7,174	1,401	24.2	7.0	8.4	87.68	88.56	.137	.167	.0128	.0146	.01032	.01018	1.24	1.43
N. Y., N. H. & Hartford	2,057	2,060	19,264	19,776	512	2.6	9.3	9.6	93.22	90.20	.095	.098	.0102	.0102	.01442	.01472	0.71	0.70
Total	5,697	5,729	45,633	50,309	4,676	10.2	8.0	8.8	88.68	89.19	.101	.117	.0103	.0112	.01145	.01134	0.93	1.03
Trunk Line Roads.																		
Baltimore & Ohio	4,030	4,006	80,673	78,073	*2,600	3.2	20.0	19.5	193.72	193.85	.109	.104	.0075	.0068	.00550	.00570	1.34	1.20
Buf., Roch. & Pitts...	568	569	12,697	13,508	811	6.4	22.3	23.7	148.24	145.70	.174	.177	.0102	.0097	.00508	.00498	2.01	1.95
Central of New Jersey .	610	610	19,005	21,537	2,532	13.3	31.1	35.2	75.61	75.27	.150	.160	.0099	.0102	.00839	.00840	1.18	1.21
Chesapeake & Ohio	1,794	1,827	27,212	30,535	3,323	12.2	15.2	16.7	282.00	274.00	.102	.119	.0059	.0066	.00419	.00432	1.40	1.53
Delaware & Hudson ...	843	845	13,783	21,458	7,675	54.9	16.3	25.4	117.90	121.70	.108	.151	.0064	.0085	.00636	.00663	1.01	1.29
Del., Lack. & Western .	957	957	26,593	27,441	848	3.2	27.8	28.7	165.00	175.00	.115	.109	.0089	.0078	.00780	.00765	1.10	1.03
Erie	2,151	2,151	52,825	51,514	*1,311	2.4	24.6	23.9	163.51	160.22	.115	.115	.0088	.0083	.00598	.00614	1.48	1.33
Lehigh Valley	1,445	1,440	36,792	41,431	4,639	12.6	25.5	28.8	169.85	169.43	.117	.130	.0085	.0087	.00626	.00631	1.35	1.37
N. Y. C. & H. R.	3,784	3,782	68,229	66,012	*2,217	3.2	18.0	17.4	190.00	195.00	.089	.081	.0071	.0061	.00571	.00624	1.24	1.11
Pennsylvania R.R.	3,897	3,903	119,036	128,024	8,988	7.5	30.5	32.9	156.02	162.33	.104	.102	.0064	.0059	.00595	.00577	1.08	1.03
Reading	1,000	1,000	40,708	40,970	262	0.6	40.7	40.9	91.81	90.90	.143	.141	.0093	.0087	.00744	.00748	1.25	1.17
Western Maryland	540	540	5,920	6,224	304	5.1	11.0	11.5	92.10	95.24	.113	.099	.0119	.0096	.00730	.00678	1.64	1.41
Total	21,619	21,630	503,473	526,727	23,254	4.6	23.2	24.3	153.81	154.89	.121	.124	.0094	.0081	.00633	.00637	1.34	1.30
Southern Classification.																		
Atlantic Coast Line...	4,334	4,361	17,850	22,724	4,874	27.3	4.1	5.2	143.16	147.66	.100	.126	.0133	.0152	.01292	.01235	1.03	1.23
Central of Georgia	1,878	1,899	9,047	10,218	1,171	12.9	4.8	5.4	149.94	149.76	.124	.137	.0130	.0106	.00885	.00853	1.17	1.25
Louisville & Nashville..	4,131	4,343	36,633	39,528	2,895	7.9	8.9	9.1	159.88	168.45	.114	.116	.0093	.0090	.00803	.00801	1.16	1.12
Mobile & Ohio	926	926	10,014	10,091	77	0.7	10.8	10.9	234.93	244.65	.113	.106	.0090	.0077	.00639	.00620	1.41	1.25
Nash., Chat. & St. Louis	1,226	1,230	9,080	9,080	.....	....	7.4	7.4	161.22	170.43	.111	.373	.0100	.0090	.00897	.00887	1.12	1.01
Norfolk & Western ...	1,853	1,876	31,017	36,910	5,89[illegible]	19.0	16.7	19.7	260.11	260.24	.100	.116	.0062	.0074	.00460	.00523	1.28	1.41
Seaboard Air Line.....	2,611	2,611	9,860	12,210	2,35[illegible]	23.8	3.8	4.7	158.55	159.25	.098	.121	.0103	.0119	.01121	.01118	0.92	1.07
Southern Railway	7,374	7,547	47,118	55,409	8,291	17.6	6.4	7.3	157.92	165.25	.129	.164	.0105	.0124	.00832	.00834	1.26	1.48
Total	24,333	24,793	170,619	196,170	25,551	14.9	7.0	7.9	178.21	183.21	.111	.157	.0102	.0104	.00865	.00859	1.17	1.24
Central Classification.																		
Chic., Ind. & Louisville.	600	600	5,728	5,428	*300	5.5	9.5	9.0	153.00	153.00	.134	.134	.0109	.0105	.00790	.00810	1.37	1.29
Cin., Ham. & Dayton...	1,038	1,038	13,770	13,461	*309	2.3	13.3	13.0	115.86	115.85	.201	.201	.0136	.0125	.00592	.00590	2.30	2.11
C., C., C. & St. Louis..	1,983	1,983	23,574	23,189	*385	1.6	11.9	11.9	152.60	153.20	.116	.107	.0085	.0073	.00566	.00572	1.50	1.34
Grand Rapids & Indiana	579	582	3,225	3,232	7	0.0	5.6	5.5	102.20	102.77	.102	.099	.0076	.0068	.00704	.00680	1.08	1.01
Lake Erie & Western..	886	886	4,603	4,916	313	6.7	5.2	5.5	140.07	130.22	.100	.116	.0073	.0083	.00637	.00702	1.15	1.23
Lake Sh. & Mich. So...	1,520	1,520	35,167	35,389	222	0.6	23.1	23.2	159.00	159.80	.090	.091	.0059	.0058	.00500	.00533	1.18	1.13
Michigan Central	1,745	1,746	18,600	18,890	290	1.5	10.7	10.8	173.00	170.00	.075	.073	.0059	.0059	.00612	.00641	1.00	0.94
N. Y., Chic. & St. Louis	523	523	7,827	10,576	2,749	35.1	15.0	20.2	210.00	224.00	.058	.079	.0048	.0062	.00513	.00511	0.94	1.22
Pennsylvania Company.	1,411	1,414	50,090	52,844	2,754	5.5	35.5	37.4	73.59	75.32	.144	.143	.0083	.0078	.00603	.00600	1.38	1.31
Pitts., C., C. & St. Louis	1,429	1,472	22,942	22,910	*32	0.1	16.0	15.6	97.64	99.95	.076	.072	.0060	.0053	.00655	.00630	0.91	0.83
Pere Marquette	2,333	2,298	17,127	18,365	1,238	7.2	7.3	8.0	170.86	169.11	.136	.154	.0098	.0113	.00550	.00546	1.78	1.85
Vandalia	828	829	7,441	7,827	386	5.2	9.0	9.4	103.84	104.99	.112	.105	.0087	.0078	.00696	.00680	1.24	1.14
Total	14,875	14,891	210,094	217,027	6,933	3.3	14.1	14.5	137.64	138.18	.112	.110	.0081	.0080	.00618	.00625	1.32	1.28
Western Classification.																		
Atch., Top. & Santa Fe.	9,189	9,350	42,134	46,605	4,471	10.6	4.6	5.0	393.93	403.00	.075	.076	.0071	.0068	.00956	.00957	0.75	0.71
Chicago & Alton	970	970	9,737	10,548	811	8.3	10.0	10.9	172.43	165.94	.108	.109	.0083	.0076	.00638	.00604	1.30	1.26
Chic. & Eastern Illinois	948	948	17,949	18,700	751	4.2	18.9	19.7	152.06	155.46	.174	.171	.0104	.0096	.00467	.00480	2.23	2.01
Chicago & North-West'n	7,454	7,623	54,911	57,413	2,502	4.6	7.4	7.5	144.07	144.46	.140	.167	.0106	.0106	.00888	.00904	1.20	1.17
Chic., Burl. & Quincy..	8,927	9,134	50,360	51,362	1,002	2.0	5.6	5.6	241.51	250.19	.093	.092	.0069	.0063	.00698	.00690	0.98	0.91
Chicago & Gt. Western.	818	818	7,317	7,438	121	1.6	8.9	9.1	265.17	271.20	.086	.087	.0084	.0077	.00687	.00656	1.22	1.17
Chic., Mil. & St. Paul..	7,187	7,187	39,821	42,533	2,712	6.8	5.6	5.9	177.99	180.29	.087	.088	.0085	.0082	.00861	.00855	0.99	0.96
Chic., Rk. Island & Pac.	7,218	7,780	37,862	41,261	3,399	8.9	5.2	5.3	220.66	219.47	.106	.111	.0088	.0086	.00807	.00844	1.09	1.01
Chic., St. P., M. & Om..	1,711	1,711	11,887	11,887	.....	....	6.9	6.9	146.07	144.97	.142	.177	.0126	.0111	.00931	.00884	1.36	1.26
Colorado & Southern...	1,858	1,858	7,058	9,049	1,991	28.2	3.8	4.9	134.00	151.00	.109	.124	.0077	.0088	.00938	.00942	0.82	0.93
Denver & Rio Grande..	2,177	2,552	10,159	10,262	103	1.0	4.7	4.0	126.28	128.70	.110	.108	.0094	.0091	.01293	.01345	0.73	0.67
Dul., S. S. & Atlantic..	591	591	2,842	2,847	5	0.2	4.8	4.8	69.23	72.40	.167	....	.0125	.0120	.00855	.00858	1.46	1.39
Great Northern	6,109	6,109	33,196	38,385	5,189	15.6	5.4	6.3	253.04	254.46	.096	.110	.0060	.0063	.00719	.00684	0.84	0.92
Illinois Central	4,424	4,377	55,575	56,949	1,374	2.5	12.5	13.0	242.99	244.84	.116	.116	.0089	.0086	.00555	.00576	1.60	1.50
Iowa Central	558	558	3,024	2,968	*56	1.8	5.4	5.3	172.48	167.67	.105	.112	.0072	.0071	.00565	.00604	1.27	1.18
Kansas City Southern..	827	827	6,918	7,285	367	5.3	8.4	8.8	270.73	278.34	.111	.113	.0070	.0066	.00599	.00636	1.16	1.04
Minn. & St. Louis.....	799	799	3,199	4,078	879	27.5	4.0	5.1	93.52	97.38	.160	.203	.0129	.0151	.01033	.00995	1.25	1.52
Minn., St. P. & S. S. M.	2,282	2,282	11,912	12,795	883	7.4	5.2	5.6	222.50	224.70	.137	.143	.0093	.0096	.00664	.00716	1.40	1.35
Missouri Pacific	6,276	6,376	38,977	36,932	*2,045	5.2	6.2	5.8	222.12	228.57	.122	.114	.0084	.0074	.00705	.00715	1.20	1.04
Mo., Kan. & Texas.....	3,043	3,072	16,824	18,796	1,972	11.7	5.5	6.1	240.13	244.74	.111	.105	.0120	.0110	.01068	.01076	1.12	1.02
Northern Pacific	5,429	5,448	36,097	42,320	6,223	17.2	6.6	7.8	341.60	328.80	.087	.108	.0069	.0077	.00839	.00879	0.82	0.87
St. Louis & San Fran...	5,069	5,062	24,286	26,702	2,416	9.9	4.8	5.3	159.30	158.10	.120	.124	.0093	.0088	.00843	.00889	1.10	0.99
St. L. & Southwestern..	1,452	1,452	9,723	9,651	*72	0.7	6.7	6.6	239.29	239.58	.165	.156	.0142	.0131	.00980	.01072	1.45	1.22
San Antonio & A. P....	724	724	1,702	1,630	*72	4.2	2.3	2.2	156.19	156.88	.099	.089	.0108	.0095	.01478	.01713	0.73	0.62
Southern Pacific	9,459	9,694	42,903	42,608	*295	0.6	4.5	4.4	262.31	260.04	.084	.076	.0059	.0053	.01025	.01105	0.67	0.56
Texas & Pacific	1,848	1,885	8,656	11,452	2,796	32.3	4.9	6.1	203.04	211.66	.089	.102	.0090	.0101	.01030	.00990	0.87	1.01
Union Pacific	5,404	5,645	23,254	24,970	1,716	7.4	4.3	4.4	410.00	405.00	.057	.059	.0035	.0037	.00753	.00819	0.47	0.45
Wabash	2,514	2,514	18,081	23,536	5,455	30.2	7.2	9.4	228.46	228.01	.075	.094	.0058	.0067	.00515	.00524	1.12	1.27
Wisconsin Central	1,018	1,018	8,309	8,309	.....	....	8.2	8.2	185.12	184.03	.167	.168	.0103	.0103	.00661	.00693	1.56	1.48
Total	106,283	108,364	634,673	679,271	44,598	7.0	5.9	6.2	211.93	213.79	.114	.119	.0089	.0087	.00829	.00852	1.13	1.09
Total all roads .	172,807	175,407	1,564,492	1,669,504	105,012	6.6	9.0	9.5	175.25	177.52	.114	.120	.0091	.0088	.00789	.00788	1.19	1.21

*Decrease.

the individual averages, of course, are exactly correct. The fact that the group averages are not weighted was occasioned by the form in which some of the information was received and the impossibility of securing additional data for the earlier year in some cases; but the errors are very slight.

The 65 roads covered by the figures had a total freight equipment of 1,669,504 cars in 1907, an increase of 105,012 cars, or 6.6 per cent. over 1906; and an increase of 563,236 cars, or nearly 51 per cent. over 1900.

The Interstate Commerce Commission finds that there were 1,837,914 freight cars in service on June 30, 1906. Approximately 300,000 cars were added during 1907, making a total of 2,127,797 cars in service on June 30, 1907, not including private cars and not including cars scrapped during the year. According to *Poor's Manual*, which presumably includes private cars, there were 1,979,667 cars in service in the country in 1906 and 1,350,258 cars in 1900. If we add 300,000 cars to the 1906 compilation of *Poor's Manual* and subtract therefrom the number of cars in the country in 1900, as derived from the same source, the net increase for the period appears as 929,349 cars, but the total number of cars built during those seven years, 1901 to 1907 inclusive, in the United States and Canada (excluding cars built at railroad shops) was 1,203,696, if allowance is made for the fact that Canadian figures are included in the cars *built*. The fact remains, nevertheless, that something like 300,000 freight cars have disappeared in the last seven years. This is a very striking commentary on the replacement of small cars with big ones, and on the fact that small cars are unsafe between big cars in long freight trains.

The Reading heads the list in 1900, 1906 and 1907 alike, in the number of freight cars owned per mile of road. Next, in 1907 comes the Pennsylvania Company; then the Jersey Central and the Pennsylvania Railroad. These are the only lines in the group that have more than 30 freight cars per mile of road. The best statement, however, to show how much of its own work a railroad does with its own cars, is that contained in the column showing the number of freight cars, as given in the annual report of the company, compared with the revenue ton-miles of the road. This table shows at a glance which roads are the borrowers and which are the lenders. The best equipped road in the list for the 1907 year, as gaged by this standard, was the Atlantic Coast Line, and the Maine Central was next, although both of these roads own a relatively small amount of equipment in proportion to their mileage. Roads which participate extensively in through hauls can, of course, do their business with a relatively small number of cars owned per revenue ton-mile. Thus, the Lake Shore & Michigan Southern is almost at the bottom of the list in freight cars per 1,000 miles of revenue freight business done, the only roads in the list with a smaller percentage being the Southern Pacific, the P., C., C. & St. L. and the Union Pacific. Measured by the number of freight cars, as shown in the annual reports, per thousand dollars of freight earnings, the road with the highest proportionate number in 1907 was the Cincinnati, Hamilton & Dayton, with the Chicago & North-Western next, these two being the only roads on our list having more than two freight cars per thousand dollars of freight earnings. The Harriman roads make the low showing in this comparison also.

The greatest increase in freight equipment in 1907 over 1906 is that of the Pennsylvania Railroad, which shows a net increase of 8,988 cars. The Southern Railway, with an increase of 8,291 cars, comes next, and the Delaware & Hudson, with 7,675 cars, is third. In all, seven companies out of the 65 showed a net increase of 5,000 cars or more during the year; a very striking figure. The most important decreases in the year were those of the Baltimore & Ohio, the New York Central and the Missouri Pacific, although in each case these were doubtless offset to a material extent by the increased capacity of new equipment built.

The road with the greatest average freight haul in 1907, as in 1906, was the Union Pacific, with an average haul of 405 miles. The Atchison, with 403 miles, is second in 1907, and was also second in 1906, although its average haul was somewhat shorter then. These two roads are the only ones on the list which have an average haul of 400 miles or anything like it. The Northern Pacific, with 329 miles, is third, and the average of all the averages is 177½ miles. The shortest hauls on the list are those of the Duluth, South Shore & Atlantic, the Pennsylvania Company, the Jersey Central and the Central of Vermont. All four of these roads have an average haul under 80 miles. The San Antonio & Aransas Pass gets the highest average ton-mile rate—1.7 cents. The lowest rate is that of the Chesapeake & Ohio, which gets 4.3 mills. The Chicago & Eastern Illinois and the Buffalo, Rochester & Pittsburgh also get less than five mills. The average of the averages is 7.88 mills.

Cost of Labor in Railroad Construction.

Through the courtesy of the Erie Railroad, we are enabled to show the following table, apportioning the costs on its Erie & Jersey line between labor and materials:

Labor	35	per cent.
Masonry, exclusive of labor	6	"
Bridge material, exclusive of labor	7.5	"
Ties, exclusive of labor	3	"
Rails and fastenings, exclusive of labor	7	"
Ballast, exclusive of labor	4	"
Transportation	0.5	"
Other expenses, incl. right-of-way and tunnel	37	"

Dutch Kills Interlocking.

The photographic view, Fig. 2, with the other engravings shown herewith, illustrates a good example of excellent track work lately done by the signal department of the Long Island road. The work was carried out by the company forces under the supervision of W. H. Arkenburgh. This is a 29-

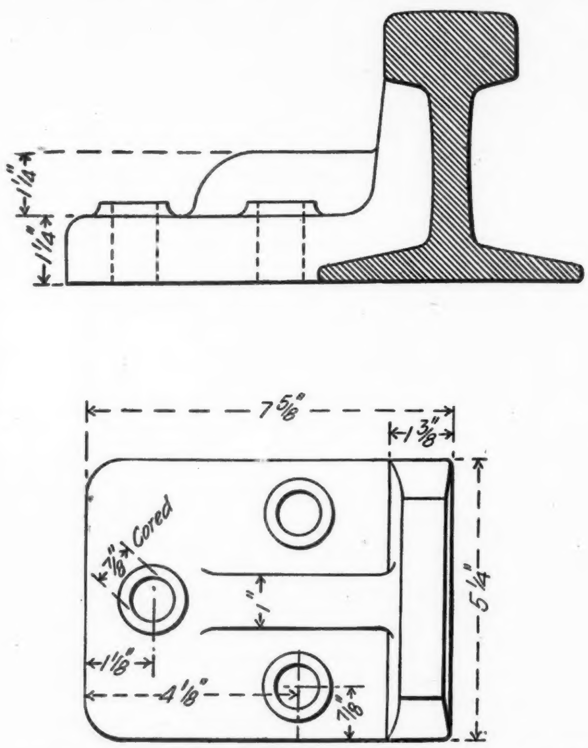


Fig. 1—Cast Iron Rail Brace for 100-lb. Rail; Long Island Railroad.

lever Union Electric machine, controlling the switches and signals at Dutch Kills drawbridge, near Long Island City, also the engine terminal near-by. It is a very busy plant, the lever movements in the summer time averaging 2,600 in 24 hours. All the work was done under traffic with no delay to trains.

Every switch and derail was equipped with new tie plates, rail braces and straps throughout. Each slip was equipped with 16 plates ½ in. x 6 in., cut and turned up in the middle and bolted together to allow for future insulation. The plates were arranged as follows: Five under each set of switch points beginning at the tie ahead of the points, and six under the frog points. Each single switch and derail was similarly equipped with four tie plates, beginning with the tie

ahead of the point. These tie plates were bolted together in the middle with two ¾ in. x 3½ in. bolts. They were equipped with ¾ in. x 2 in. butt straps, each held in place by three ¾ in. x 1½ in. rivets with countersunk heads. The riser plates were made of ⅜ in. x 6 in. iron, fastened to the tie plates by four ¾ in. x 1 in. countersunk head rivets each. The rail braces are cast iron, Weaver type, held in place by three ¾ in. x 6 in. lag screws each. In addition, each plate is held in place by two ¾ in. x 6 in. lag screws, placed on each side of the turned-up portion, and one lag screw of the same size in each end outside of the butt strap. These outside lag screws also hold in place the ¾ in. x 2½ in. iron straps which run the full length of the slip or switch, except where the ties are held from shifting by the bed-plate of the switch-and-lock movement.

Fig. 2—Switch Slip at Dutch Kills, L. I.

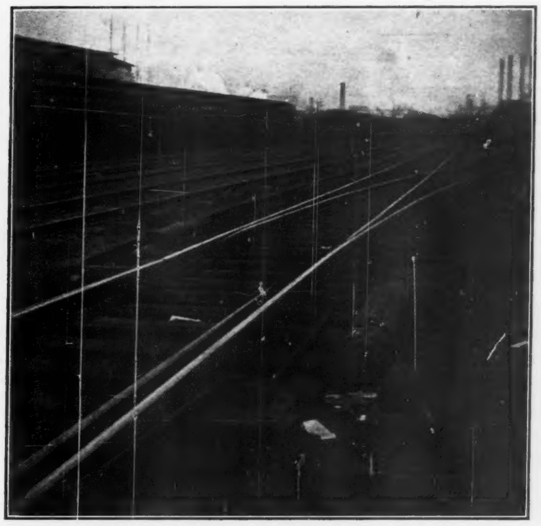


Fig. 3—Switches at Dutch Kills, L. I.

In the case of single switches and derails the points are tied to the stock rail by ¾ in. x 2½ in. x 15 in. iron straps secured by four bolts ¾ in. in diameter, through the web of the rail, to prevent running. The same result is accomplished on slips by a piece of ¾ in. x 2½ in. iron bolted through the middle to the center of each wing rail and turned down and lagged by each end to two ties by ¾ in. x 6 in. lags. Another piece of iron of the same size, bent at an angle of about 120 deg., is bolted through its apex to the outside of the knuckle of the frog, and through its extremities to the stock rail. The rigidity of this construction is shown by the fact that no switch point in this plant has run more than ¼ in. during six months.

The detector bars are operated through rocker shafts, and work in Higgins clips. The knuckle bars on the frogs are hinged in the middle so that they lie always against the rail. Fig. 2 gives a general view of one of these slips showing the heavy construction. Fig. 3 shows switches 17 and 19. In this case there are nine plates for the two switches. Fig. 1 shows the Weaver rail brace for 100-lb. rail as used in this plant. All rails are 100 lbs., except on the sidings. Fig. 4 is a general plan showing the method of tying in the points over a slip and movable point frog. This plan was made for a mechanical plant, and consequently does not show as many plates as are used at Dutch Kills.

The drawbridge is locked by means of ordinary facing point locks, inside connected, one at each end of each track. These facing point locks are operated through a ground lever by the bridge tender, but his pipe line is locked by an electric switch and lock movement at each end of the bridge.

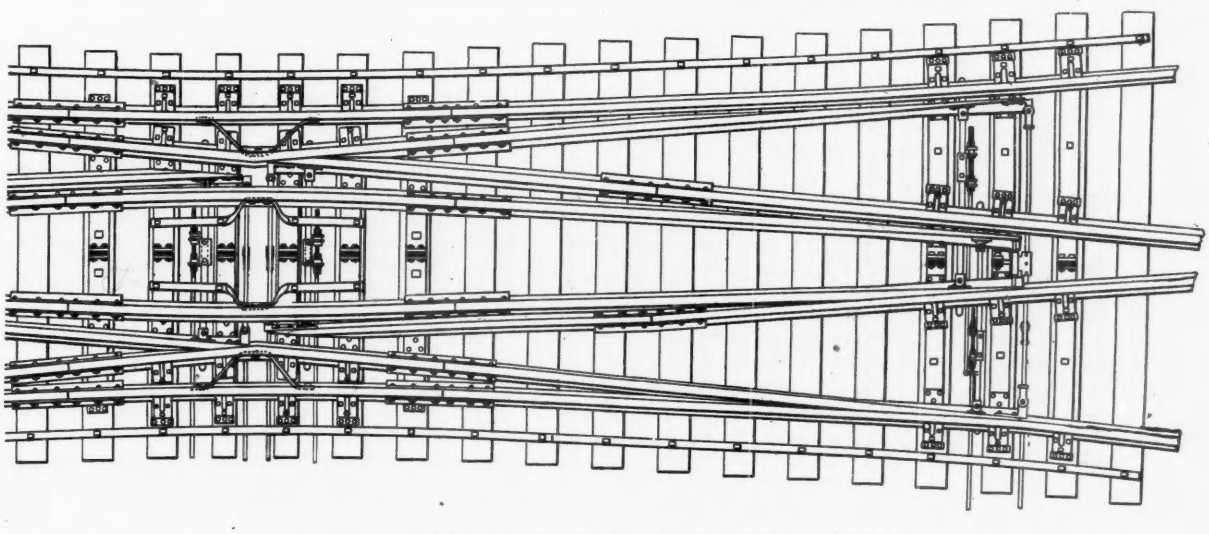


Fig. 4—Double Slip Switch; Long Island Railroad.

All the wiring of this plant is in trunking on stakes, except where it goes under the river in submarine cable. All this wire was overhauled and all underground soldered joints eliminated. All signals and circuit controllers are mounted on concrete foundations.

They began clearing the snow on the Christiania-Bergen Railroad April 6. A month later it was announced that trains were not likely to run through before June.

Reducing Per Diem Charges Upon Freight Cars.

BY F. LINCOLN HUTCHINS.

It is the natural object upon all railroads to reduce the charges accruing from the use and detention of foreign freight cars, and this can be effected by: (1) Quicker movements between terminals. (2) Shortening the time of detention at terminals.

Under the first head there may be:

(a) An adjustment of load to the capacity of locomotives so as to secure the maximum speed.

(b) Regularity of service so as to obtain a fairly continuous movement.

(c) Marshaling of cars in trains so that the longest possible run may be made without remarshaling.

(d) Moving trains out of terminals as soon as made up.

Under the second head there may be:

(e) Checking up of the time cars remain at stations and deducing an average time of detention therefrom.

(f) Requiring a clean-up of line-of-road yards once in each 24 hours.

(g) Securing prompt handling of all bad order cars.

(h) Co-operating with shippers and consignees in the discharge and loading of cars.

Using these eight propositions as texts they may be further explained and means suggested to carry them into effect. It is not to be expected that even with the most perfect system it would be possible to obtain immediately all the suggested improvements; real improvements are matters of growth, point by point toward well conceived ends. The following suggestions are offered as outlines of plans toward which to aim and work with the conviction that special efforts along these lines would effect great improvements, not only in the matter of car movement, but in the direction of the greater end of efficient and economical management.

(a) It may well be that the schedules for locomotive loading, whether by theoretical rating or by actual dynamometer tests, may be just a trifle more than the real every-day capacity of the locomotives, so that in place of hauling the trains steadily along over the hills and around the curves at the scheduled speed they may drag along, getting stalled in the hard spots and becoming obstructions to other movements. The despatchers' train sheets should contain the facts which determine this matter, and they are worthy of careful study in this regard. The giving of bonuses to all who can contribute to an improvement in this respect would accomplish surprising results.

(b) The very great importance of continuous, uninterrupted movement as a means to prevent congestion is not appreciated except by those who have given the matter special attention. In driving logs it is well known that if all can be kept moving steadily a small stream will carry a prodigious number, but the moment a single log becomes wedged in going around a bend, or gets jammed in a narrow part, then a congestion occurs out of all proportion to the small original cause. The narrow, contracted quarters of the Park square subway station of the Boston Elevated Railway afford accommodation for upward of 30,000,000 passengers yearly—more than any steam railroad station in the United States, although its entire area is less than that of many of the retiring rooms of the latter. This is made possible by the steady stream of cars passing uninterruptedly around the loop; the slightest hitch in this regularity immediately causes congestion of serious proportions. Is it not worthy of careful study to see if something approaching a like regularity may not be obtained in the movement of freight cars through terminals and upon the road? Such regularity cannot be had without an adjustment of the load to the capacity of the power moving it, so that the limit of speed and schedule arrivals may be insured.

(c) Is it not worse than waste to reswitch trains at nearly every junction when all are contained within one system under one operating head?

If all cars received at important terminals and junction points destined to points at the extreme ends or beyond the lines of the system could go through in solid trains, without being reswitched, there would be gained not only a surprising amount of time, but junction yards would be relieved and switching service saved, not to say anything about the incidental breakages and costly delays. To accomplish such an improvement requires the proper marshaling of cars at terminals with the holding back of cars to go in such solid trains.

The cry will be raised immediately that this is impossible because of the lack of room and switching power, which may be true as regards some points, but a serious study of the situation would result in the adoption of this plan in places where it is not now obvious how it may be undertaken, with the result of such a relief to junction yards so soon as it was determinedly entered upon as would compel the extension of the plan; the saving at congested switching points would induce the management to make such improvements at terminals as to make possible the extension of the principle of marshaling cars so as to obtain the longest possible run of the cars in solid trains, regardless of division boundaries. A very effective means to this end is laying of permanent, or even temporary, tracks out of congested terminals upon which to draw or push trains as fast as made up, thus leaving the switching territory free to marshal other trains; the capacity of a small switching area can in this manner be largely increased with a limited expenditure.

Why should a solid train received at RO, destined P, be set off and taken on at four or five junctions, with the inevitable delays accruing therefrom, when two runs of 10 or 12 hours each would dispose of it, and how much worse it is to make up the trains in a mixed fashion and reswitch from four to six times, consuming double or treble the time to get the cars home.

To obtain the quickest, most economical service any system with one operating head must be considered an entity unbroken by divisional lines.

(d) Positive instructions are necessary requiring divisional authorities to relieve important terminals of trains as fast as made up, thus leaving yards clear for switching purposes.

(e) Reduction in the time of detention at stations requires a positive check upon the handling of cars by agents. Such check can be obtained in no better way than by proper records, showing time of arrival and departure; it will probably be also necessary to have time of placing for loading and unloading. There are many ways of effecting this, among which are:

(i) Statements of cars forwarded, with time of arrival and handling.

(ii) Statement of cars received, with leaving and handling records.

(iii) Statement showing cars on hand and location, with lading, etc.

(iv) Slips made in duplicate for each car received, having such information as to lading and disposition as may be found useful; the original to go to some subcentral office, say the division superintendent's, the duplicate held by the agent, to be indorsed with subsequent records and upon despatch of the car to be forwarded to the same point as the original and checked up therewith. By keeping these slips in date order both the agent and the supervisor are kept in touch with the exact situation as if they had the cars in miniature at their finger ends and under observation.

If the list plan is preferred the first is the best, but it is open to many objections: It requires more work and attention on the part of the agent and the supervisor; the supervisor cannot know of delayed cars until they move out of the station; the last objection makes necessary a supplementary statement, such as number iii; wilful misstatements are possible and difficult of detection; by the fourth method these objections are minimized, if not entirely eliminated; the slips being consecutively numbered, are quickly handled, and by removing the original slips as fast as their numbered duplicate comes to hand both the agent and the supervisor have a perpetual, graphic inventory of cars on hand, with the date of receipt of each shown by its position in the file; this slip being made upon the arrival of the car any subsequent misuse cannot be covered up or overlooked.

(f) It should be the settled policy to require the cleaning up of all line-of-the-road stations of all cars ready to go at least once in every 24 hours.

(g) Many constricted switching areas are seriously hampered by bad order cars on hand, and a careful consideration of the best method of remedying this trouble should be made by persons having access to authority sufficiently high to effect

a cure; more and better inspection may be found to be highly economical in the end.

(h) In the times of Miles Standish it may have been very well to hold to his famous motto: "If you'd have a thing done do it yourself"; but in these larger days of greater complexities it is, "If you'd have a thing done engage a specialist"; and no large improvement in any direction can be effected without some one head being engaged specifically with that problem to the exclusion of all others. The division superintendents have too many demands upon their time and energies to become specialists in any one line, or, if there should be one that does, other interests suffer.

The time was when the captain of a sailing vessel was equal to any emergency, from being cook to physician or minister, but now the captain of the great liners, having charge of no greater interests and overseeing the expenditure of a less amount of money than many of the division superintendents of the larger systems, has a large staff of officers, each of whom has his own particular department to conduct practically free from the captain's interference, except in the matter of general direction. Is it not time that there should be some approach to such expert staff assistance in conducting transportation operations upon land?

In the matter of improved car movement it is absolutely necessary to have one central head for any entire system, who should be upon the staff of the operating official, reporting to and being held responsible by him. It is immaterial as to his title—some roads have a superintendent of transportation charged with this duty, but usually as a side issue, and the creation of a new official, with the distinctive title of superintendent of car movement, charged with this single transportation problem, would prove an economical advance.

It would be unfortunate to place this official under the car service, the traffic or other department, as the interests of those are oftentimes in direct opposition to that of the operating department, which has oftentimes seen its expense inordinately swelled by the efforts of the car service department to make a showing with respect to penalty per diem payments; it is poor economy to spend $10 for the purpose of avoiding the payment of $1, and as the operating department is ordinarily responsible for unnecessary per diem it is proper that it should be charged with the responsibility for it and entrusted with the methods for its reduction.

To bring about the largest economies divisional lines should not be allowed to control movements, and hence the man in charge of car movements should not be hedged in by the limited authority of division superintendents.

It goes without saying that any man worthy of such a position would work in conjunction and harmony with the traffic, the car, and the master car builders' departments, as well as with the division superintendents and despatchers. He could not well do otherwise, as the active co-operation of all of these is necessary to the successful outcome of his work, yet from the very fact that his operations must intimately touch all of these varied interests it becomes imperative that he should be accountable to the head of the operating department alone.

In order to keep in touch with the actual situation all over the system he should be supported by a corps of good men, whom he could distribute as the needs demanded. These men having no authority, but having advisory and supervisory powers, would be of great assistance to agents, and, what is more important, afford a more direct connection between the operating officials and the shipping public whereby more harmonious relations may be secured. Is it to be doubted that by personal attention a good man could become an important lever through which to secure a more expeditious movement of the lading from and to the cars, or, failing this, to effect an embargo to prevent cars from blocking up a terminal when their contents could not be disposed of, which is a matter that has had practically no attention up to the present?

As a means of increased efficiency the graphic representation of conditions and performance has great merit, which, coupled with a bonus or premium for excellence of performance, may be made to produce gratifying results, and a good superintendent of car movement would not neglect so efficient an aid.

To sum all up it may be said that an efficient superintendent of car movement, supplemented by competent assistants, working in harmonious conjunction with all other departments along the lines here laid down, would not only effect great saving in the charge for car use, but, what is more important, materially improve and economize the whole operating service.

International Boiler Makers' Association.

At the first annual meeting of the International Boiler Makers' Association, held in Detroit, Mich., May 26-29, E. W. Rogers, of the Rogers Works of the American Locomotive Co., presented a report on the best methods of cleaning locomotive flues. The report covered the use or non-use of brick arches, the use of wide copper ferrules, treatment of water in bad water districts, methods of setting tubes, and the care of locomotives, especially as regards placing them over ash pits. The press report says F. M. Whyte, General Mechanical Engineer of the New York Central Lines, said that it would not be practicable for anyone to say which is the best method of setting tubes, as these vary according to the different locations.

J. T. Goodwin, of the Richmond Works of the American Locomotive Co., presented a report of the special committee on "Boiler Explosions, Their Cause and Remedy," his associates being T. C. Best, J. Kelley, H. L. Wratten, J. A. Doarnburger and C. H. Hempel. This report includes data covering all kinds of boiler explosions from 1879 to 1907, their causes, and the number of people killed and injured. The report places the aggregate number of explosions at 8,512, in which 8,433 persons were killed and 12,734 injured. In 1907 there were 471 explosions, 200 persons being killed and 420 injured. The total number of locomotive boiler explosions alone from all causes during the past 10 years was 232. The proper safeguards mentioned are conscientiousness, intelligence, correct design, the employment of reliable and experienced makers, capable men in charge of construction, periodical inspection, prompt reports and the removal of boilers before deterioration sets in.

Garland P. Robinson addressed the convention by invitation, and spoke of the rules of the New York Public Service Commission. Of 17 accidents reported in the past year, only three were explosions of locomotive boilers. The few explosions that occurred were due chiefly to low water, and Mr. Robinson expressed the opinion that sufficient care is not given to water glasses and gage cocks, especially in the matter of keeping them clean.

George Wagstaff, president of the association, said that the locomotive inspectors in New York state had originally been looked on as persecutors, but they had been found to be reasonably fair minded men and were simply doing their duty.

Overwork in England.

The British Board of Trade has just issued its report of the number of railroad employees overworked during the month of January last. This report, based on returns sent in by the railroad companies, shows the total number of cases, in each of the principal classes of employees, where a man has worked more than 12 hours at a time, or, after being on duty more than 12 hours, has resumed work with less than nine hours rest. A supplementary table (table No. 2) is presented showing the number of cases where the stipulated time was exceeded, but deducting time spent in traveling home after being relieved. The total number of persons shown in the report is 113,558, and during the month of January these employees worked 2,887,388 days. The number of cases on which they were on duty 13 hours or more was 74,220, equal to 2.57 per cent. of the total days worked. The table showing the net overtime (excluding time spent in going home), includes only the trainmen and does not cover all of the roads; but so far as it goes, it shows considerably smaller percentages of overwork. For example, table 1 shows overwork by passenger enginemen in 4,540 instances; table 2, only 3,477. Freight trainmen, table 1, 13,658; table 2, 6,672; freight trainmen, table 1, 40,321; table 2, 22,324. Of the 74,220 instances of overwork in table 1, only 4,093 are cases in which the man worked 16 hours or more.

Preventable Wastes and Losses on Railroads.

BY HARRINGTON EMERSON*

"Being content with loose, inaccurate and incomplete knowledge on important subjects is said to be one of the economic sins of the American people, and we are certainly open to the charge."—*Railroad Gazette*, May 8, 1908.

This statement in a journal which is an authority in all matters appertaining to railroads has suggested an analysis of the conditions which make railroads so wasteful, and also a brief outline of the methods by which these losses could be reduced and ultimately entirely eliminated. There are a number of reasons why so great losses occur in railroad operation and maintenance.

Different lines of human activity have each worked out methods which solved one particular part of the problem. No single line of activity has adopted all the methods which would have made it economically perfect in all its operations. Railroads have revolutionized land transportation, banking has perfected methods of detail records, a department store rapidly anticipates the wants of the shopping public, etc., etc. It is because no line of business has as yet adopted the best methods to all its parts that great inequalities of excellence occur. It is probable that a traveling circus of the first class is the most efficiently conducted organization in existence. Every member, human or animal, is a specialist of the highest order; every act is of supreme efficiency, and this applies even more to the putting up and taking down of the tent, to unloading and loading, than to the performances.

Railroading has attracted many of the most brilliant organizing and operating minds that the last two generations have produced, but for that very reason these men have been of supreme ability as to the chief problem, rather than of all-around excellence as to the lesser problems.

A man, however great, cannot, at the same time and equally well, look with one eye through a telescope and with the other through a microscope. Railroad problems have been handled with the telescope rather than with the microscope.

The difficulties encountered with the big problems were so great that the little problems were overlooked.

Railroading is a new business, scarcely two generations old, and it has grown so fast and so strenuously that it has not had time to adapt much either from its predecessors, from its contemporaries or from its juniors in other lines of business activity. Railroad development has therefore been one-sided.

Any business, railroading included, is, like a cable, composed of many strands. If each strand is half rotten, the cable as a whole will be weak. The individual elements out of which railroad maintenance and operation are built up are nearly all of them weak and inefficient.

"Being content with loose, inaccurate and incomplete knowledge," railroading has overlooked the following facts:

The only way to measure efficiency as to any item, whether great or small, is to establish *standards*.

Railroads do not have any efficiency standards for minor units.

Where there are no efficiency standards it is impossible to have definite and localized responsibility.

Few men realize the very great inefficiency with which most activities are carried on. High efficiency is the rare exception.

A "dependent sequence" of minor units can very easily become more important than a single, great problem. Three efficiencies of 60 per cent. each, if in "dependent sequence," cause a final resultant efficiency of only 21.6 per cent.

It is enormously difficult, but not impossible, always to attain an average efficiency of 100 per cent. as to each detail unit, and therefore as to the whole. The circus does it.

No other kind of improvement policy can approach in rapidity of economic result, or in magnitude of economic result, the efficiency policy of 100 per cent. perfection in minor units.

An efficiency policy cannot be successfully carried out by men trained in other lines, animated by other ideals and overburdened with other responsibilities. The standards and methods must be provided by competent specialists. When they are in working order, and not before, they can be entrusted to those less familiar with them.

It costs much less to improve and perfect what is already in existence than to replace what is old with something far more expensive, but relatively no more efficient. The mere change from lesser to larger method does not increase efficiency, even if it does occasionally lower costs.

Efficiency methods have been tried on a scale sufficiently long and sufficiently large, including large departments in railroading, to demonstrate their value.

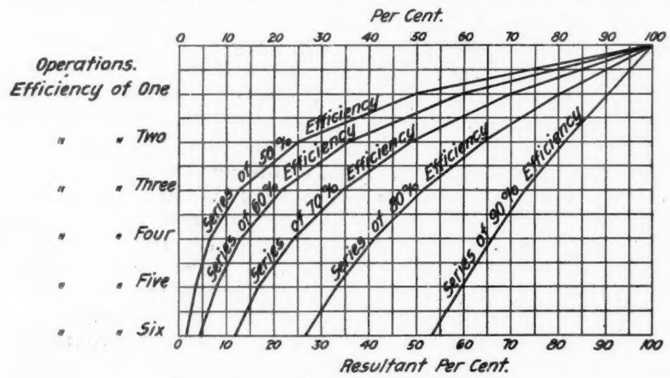
An average efficiency of 100 per cent. in minor units will reduce operating and maintenance expenses one-half.

Owing to low efficiencies in details, preventable and unnecessary losses and wastes in American railroad operations aggregate $300,000,000 a year.

These 18 paragraphs summarize the situation. For the benefit of those to whom the subject is new some of the paragraphs will be taken up separately.

Each line of business has developed perfection as to its own most important part. No business has thus far combined all kinds of perfection.

The chief business of railroading has been to provide lines of land transportation and to revolutionize transportation



Dependent Sequence Operations.

methods. In this it has been eminently successful. A recent example illustrates the methods of early railroading. In 1898 it cost as high as 60 cents a pound to move freight over the White Pass in Alaska from tidewater to river. During the severe winter of 1898-9 a railroad was built from Skagway to the summit of the White Pass; 500 men were employed as snow-shovelers and twice daily, all winter long, they shoveled the snow from the roadway up the Pass. Wages were very high and the increase of cost owing to winter-building was close to $1,000,000 or $50,000 a mile. Yet this was splendid railroading, proposed by bold American engineers, carried out with bold British capital (American capital was too timid). The railroad was completed in time to take in the spring rush of freight, estimated at 40,000 tons, at 3 cents a pound. Not only did the railroad make a gain of a year on an enormous and profitable tonnage, but the lessening of freight costs to the public was also enormous. It would have been a petty and shortsighted economy to have waited until summer to build the road. Two other Alaskan lines were built by Mr. Charles D. Lane in defiance of all rules of railroading, except the supreme rule of common sense. Both his roads earned enough in their first three months of operation to pay for their construction, yet one of them was not surveyed until after it was built and in operation.

To obtain the right point of view as to railroad conditions we cannot compare one railroad with another, for they are all in the same boat, but we must compare railroads with other lines of human activity. Let us therefore imagine a bankers' magazine making the following remarks about the elementary acts of banking operations:

"No given individual is made responsible for money, and when it is borrowed it is seldom returned."

"Believing that the bank has plenty of money, there are employees who will waste it."

"Valuable securities have a way of disappearing, and it is impossible to trace them. They are seldom returned."

*Mr. Emerson, who is a well-known efficiency and standard practice engineer, has made efficiency reports for the following railroads and industrial plants: Pennsylvania Railroad; Chicago, Burlington & Quincy Railroad; Union Pacific Railroad; Grand Trunk Railway; Atchison, Topeka & Santa Fe Railway; Chicago Pneumatic Tool Company; Bethlehem Steel Company; International Harvester Company; American Locomotive Company.

"I do not know the methods of banking practice elsewhere, but in my bank there is a general mix-up. One man keeps accurate accounts and another does not."

"Nearly half the money put into the safe is not used in actual money-making business."

It is because bankers have unit standards and railroad men do not that extracts like the above are impossible as to banking and universal as to railroad operations. Theoretically there is no real difference between the bank's customer who makes a deposit and checks against it and the railroad's employee who does work and draws a salary or wages. The bank will not, however, give credit for one single cent that it has not received, and it watches very closely to see that the depositor does not overdraw. It knows every single night before business is closed just exactly how it stands as to all its depositors.

Following are extracts from the *Railway Master Mechanic* for May 1908:

"Time is lost by men in a locomotive repair shop by dearth of handy tools. No given individual is made responsible for their care, and it is always a difficult matter to locate them when required, a search causing delay. They are seldom returned promptly and it is not uncommon for some one to wait for them."

"Unfortunately there are many apprentices who are much more fascinated by the sound of the closing whistle than by the work of the trade which they are learning." (P. 113.)

"Unintelligent readjustment will not improve the steaming qualities of a locomotive." (P. 114.)

"Believing that the company has plenty of money there are employees who will uselessly break or waste material." (P. 114.)

"Desirable tools, oil cans, etc., left on an engine have a way of disappearing, it is impossible to trace them and they are seldom returned." (P. 118.)

"A road foreman states: I am not familiar with practices followed by different railroads, I do not know how other divisions are fixed, but on my division there is a general mix-up. One man takes care of his tools, another does not." (P. 118.)

"When an accident occurs the odds are two to one that the man, not the machine, is at the bottom of it." (P. 130.)

"Nearly half the coal put into the firebox is not used in actual money-making tonnage." (P. 134.)

These extracts show not only the complete absence of standards, but actual demoralization in elementary acts which in their aggregate make up the costs of railroad operation and maintenance.

Railroading has required men of intensity capable of solving the most pressing problems rather than men capable of perfecting details as a whole.

In each generation the main problem is different. At first it was financial; next it was to aggregate and build up great systems; to-day it is both legislative and economic. The restrictions imposed by legislative action would lose many of their terrors if better methods greatly added to the net income.

The methods of the telescope and those of the microscope.

Railroad men have followed the same general line of evolution as generals, doctors, engineers. The telescope was used first, the microscope later. What is big seems at first more important than what is little, but in war more men have died from lack of elementary hygiene than from wounds inflicted by the enemy. During many centuries doctors looked to the planets and to the moon for inspiration, and it is only recently that they have discovered the microscopic germs of typhoid, of consumption, of yellow fever, not to mention the newer and revolutionary discoveries of "opsonines" and "hormones." The first Atlantic cable was burned out because the current from a very strong battery was switched into it. Messages could have been sent from a battery the size of a percussion cap holding a single drop of acidulated water, but the importance of the "little" was realized too late to save the first cable.

If a railroad had been perfectly built and equipped 20 years ago and had never been used, it would be without value to-day except for the right-of-way. It is not wear that destroys, so much as fungus, rust, rain and obsolescence. Furnaces and boilers deteriorate not because coal is burned and water evaporated, but because the coal is generally bad and the water worse. The time is fast coming when the army of railroad builders equipped with telescopes should be supplemented by a not less skilful and energetic army equipped with microscopes.

Big, immediate difficulties have obscured problems not less important, but not so immediate.

When a railroad manager is at his wits' end how to move the enormous tonnage offering, he has no time to be worried with the fact that the turning of a pair of tires may be taking 18 hours instead of two hours. He does not have time to find out whether all other minor operations are not also taking many times as long as they should and also costing many times as much as they should.

Railroading is new. Military organization is a small matter of 100,000 years old, transportation by sea is 10,000 years old, banking is 1,000 years old, textile mills are 200 years old, and, by reason of their long experience, all of these lines could teach railroaders much. Electrical equipment is scarcely 30 years old, steam turbines, automobiles, submarines, modern efficiency practice, about 10 years old, wireless telegraphy five years old, and successful motor-driven aeroplanes one year old, but all of these youngsters could also teach railroaders much. Is it not astonishing that automobiles, so recently developed, have run a mile faster and also much further in a day than even a relay series of locomotive? Is it not astonishing that when the largest steam turbine marine unit in existence only weighed 35 tons, builders were willing to undertake to build and guarantee the performance of turbine units weighing 450 tons, with a speed of 25 knots an hour on a coal consumption, all auxiliaries included, of 1.5 lbs. per shaft horse-power hour, and that the builders made good their guaranty?

A committee formed of experts in other lines of business, not one of them a railroad man, could put up a report on railroad operation that, for value and scope of suggestions, would surpass anything that an exclusive committee of railroad men could evolve. (Similarly, railroad men could offer suggestions of great value to other lines of business.) The findings of such an outside committee would not be always practical, but efficient railroad men could take hold of the findings as they would of a rich gold mine. The ore would be all there, even if it had to be mined and refined.

A complicated business like railroading is not to be compared to a single bar of steel, but to a cable of many strands.

A steel cable is stronger than a steel bar of the same weight because it is possible to secure a uniform high grade of excellence in the fine wires which is unattainable in the bar. Therefore when all the strands are bound together, in the aggregate they are stronger than the bar of the same weight. As yet railroads are using the single bar method. They cannot unravel into component parts such expenses, for instance, as the cost of running locomotives a mile. Therefore they cannot effect the economies that might be possible if each component item of expense revealed its own strength or weakness as does a single strand of steel wire. Because each strand of steel wire is strong, the whole cable is strong, but because each strand of railroad operation is inefficient the whole is inefficient from the point of view of expense.

The necessity of standards.—Horses have been trotted against each other for centuries. The races were formerly on unmeasured courses and with no times taken. One horse would beat another on one day and at another race the former best horse would be beaten. There was no knowing whether he trotted faster or slower in the latter race. When Americans began to trot horses on carefully measured tracks and measured the time by stop watches they soon reduced the time from 2.40 to 2.14. It was next discovered that three different elements enter into the making of a record: (1) The horse, (2) the track, (3) the sulky. Springy, kite-shaped, banked tracks took several seconds off the record, and low, rubber-tired wheels took several more seconds off, so that today an assembled crowd will go wild with enthusiasm if a trotter beats the record by one-fifth of a second, and will go home disappointed and depressed if the horse fails by this amount. There is a two-minute *standard* for trotting horses. A poultry fancier will breed a bird to a particular coloring of a particular feather. There are standards for poultry. If automobiles have in so short a time so far surpassed steam locomotives in speed both on short and long distance runs, it

is because standards of performance were established for automobiles and none have ever been established for locomotives.

In railroading, because a standard schedule of 18 hours is set up between Chicago and New York, the fast trains make this schedule every day. Running without schedules or standards the old Mississippi steamboats used to come along anywhere inside of a week. It is a law, almost without exception, that wherever there are no standards there is very low efficiency, and this is equally true whether the question be a moral one, a mental one or a physical one.

No railroad efficiency standards for minor units.—What sized shovel should a laborer use for shoveling coal, coke, sand, dirt? How many tons a day can a man shovel without undue fatigue? There are some 100,000 different unit operations that recur in railroad operation. As to how many of these is there any standard of time or of money expense? Perhaps as to 100, scarcely more. Piece rates may perhaps be pointed to as standards of expense. Undoubtedly they are an approximation to a standard but generally exceedingly inaccurate. Even if the piece rates were ever carefully determined they soon become obsolete, and the piece rate is only one part of the expense. As examples of railroad piece-rate practice several instances occur:

In a certain large railroad shop piece rates were put in before the invention of high-speed steel. Although these steels could reduce the time of turning tires from 18 hours to one hour, a strike was threatened against revision of the piece rates. Piece rates of this kind are evidently not standards of anything, although they are gages of shop inefficiency.

On another railroad piece rates were introduced on condition that they should be agreeable to a committee of the workers and should not be changed without consent. The introduction of this system brought about a strike, discontent continued for three years and finally culminated in another strike, the shop work of this particular railroad being distinguished for excessively high unit expense and very great inefficiency. These rates were standards of nothing. To confound piece rates with standards of cost or time is to be "content with loose and inaccurate and incomplete knowledge."

Without standards there can be no localized responsibility. When a drove of horses race together over a plain there is no knowing whether they go fast or slow, or whether the leading horse is really the fastest. Perhaps he is merely intimidating the others. If each horse is taken separately and tried out on a measured mile, the poor ones are soon weeded out and the best are picked for further development.

On piece rates a man may limit his output, may be content to earn less money working either slower or a shorter time. Limitation of output adds enormously to expense. After setting up the schedule of 18 hours between New York and Chicago, the responsibility for failing to attain it can be definitely located. Another train may fail to clear, there may be a washout, the engine may break down, a connecting train may be 10 minutes late. It is because everybody is keyed up to his particular task that this marvelous 18-hour performance is possible. A railroad is keyed up as to fast trains only; a circus is keyed up as to everything; a bank is keyed up as to immediate reliability of all records.

Railroads fear the expense of localizing responsibility. When, at a meeting of the Western Railway Club, a system of maintaining shop belting was described, and it was stated that an accurate account was kept with every belt, every failure and every repair entered against it, etc., etc., a superintendent of motive power present voiced the usual prejudice by saying that there must be more clerks and bookkeepers on the belts than there were machinists in the shop. The facts were, however, that after the accounting system was once installed it was looked after by a single belt foreman who in addition had general oversight and charge of all the belts, continuously working on belts, not on accounts.

Good belt maintenance does not consist in economizing on belt power but in preventing belt failures. In this shop belt failures had numbered 3,600 a year, but were, by the system of localized responsibility, reduced to 630. Belt renewals had cost for leather alone $12,000 a year. Expense for leather, supervision and supplies was reduced to $3,600. Six times better service cost only one-third as much.

INEFFICIENCY OF MINOR OPERATIONS.

F. W. Taylor, recent President of the American Society of Mechanical Engineers, is perhaps the greatest genius as to efficiency in shop practices who ever lived. Because he found that one tool was more efficient than another, because he followed up this fact until he understood why, he, in collaboration with M. White, developed and gave to the world high-speed steel, which has revolutionized machine shop practice the world over. This was but a little incident in Mr. Taylor's work. Wherever he turned, whether to belts or to files, to machines or to men, to methods or to materials, he found everywhere and universally the same inefficiencies that characterized the old carbon steel tools. In his great address on "Shop Management" he speaks of the efficiency of labor as follows: "The possibility of coupling high wages with a low labor cost rests mainly on the enormous difference between the amount of work which a first-class man can do under favorable circumstances and the work which is actually done by the average man. That the first man can do in most cases from two to four times as much as is done on the average is fully realized only by those who have made a thorough and scientific study of the possibilities of men."

"This enormous difference exists between the first-class and the average man in all the trades and all the branches of labor which Mr. Taylor has investigated, and this covers a large field, as he, together with several of his friends, have been engaged with more than usual opportunities for twenty years past in carefully and systematically studying this subject."

"It must be distinctly understood that in referring to the possibilities of a first-class man Mr. Taylor does not mean what such a man can do on a spurt, or when he is over-exerting himself, but what a good man can keep up for a long term of years without injury to his health, but with increase of happiness and well-being."

Mr. Taylor's assistants who learned directly from him, his disciples who have gone to him for advice and directions, have made hundreds of thousands of work schedules based on scientific time studies, and their experience corroborates absolutely what Mr. Taylor states. That industrial plant is an exceptional one in which the efficiency cannot be increased 50 per cent.

As railroads reach their highest standards in moving passenger trains regularly, as they reach fairly high standards in moving heavy trains from division to division, it is to be regretted that they are resigned to low standards in every other respect. They are not as efficient in detail units as other industrial concerns. If other industrial concerns, as shown by Mr. Taylor's experience, are so inefficient, it follows that railroads are even worse, and this has proved to be the case. A railroad shop working as high as 50 per cent. efficiency is the exception; railroad track maintenance of 50 per cent. is even less common than 50 per cent. shop efficiency. If, however, each individual item is only on a 50 per cent. efficiency, it follows that the aggregate of all expenses is double what it ought to be.

The theory of the "dependent sequence."—This theory was discovered, not invented. In pursuing efficiency work, cases occurred in which expenses were reduced to less than one-tenth of what they had been. This reduction was so startling, so incredible, that even full belief in Mr. Taylor's statement that most work was done at only 25 to 50 per cent. efficiency was not sufficient explanation. In the particular cases where so great reductions were made every step was carefully followed up to discover just where the gains occurred. It was, however, found that each step was not particularly bad, and that the average inefficiency was not large enough to account for the great loss.

It was then that the discovery was made that many elemental operations stood to one another in a relation of dependent sequence, and that where dependent sequences existed, an efficiency of 80 per cent. in each of two steps resulted in a final efficiency of only 64 per cent. If there were three dependent sequence steps, the final efficiency was only 51.2 per cent. If there were four dependent steps each of 80 per cent., then the final result was only 40.96 per cent. Three steps of 70 per cent. efficiency each, give a final of 34.3 per cent. Three steps of 60 per cent. each, give a final of 21.6 per cent. Three steps of 50 per cent. each, give only 12.5 per cent. as a final.

A two-step dependent sequence occurs when a locomotive,

owing to bad condition, can only haul at full speed three-quarters of its load, and then, owing to bad track conditions, takes one-half longer time per mile. If, owing to a wash-out, the locomotive has to go around a 25 per cent. longer track, the sequence will be one of three steps. Because it can only take 75 per cent. of its load and can travel only 67 per cent. as fast and has to go 25 per cent. further, the final efficiency of freight movement as to that train is 75 x 67 x 80, or only 40 per cent. of normal. The curves in the diagram shown herewith illustrate graphically this law. The collapse of efficiency resulting from an inefficient dependent sequence series is astounding.

The difficulty of attaining 100 per cent. average efficiency.—The correct handling of a great number of separate units is always hard unless it is done systematically. A careful woman combs and brushes her hair twice a day. There are probably 40,000 separate hairs, each one of which has to be straightened out. Some savages never comb their hair and the only way to straighten out the tangled mass would be to cut it all off close to the scalp and start in fresh, keeping the new hair straight while it is growing. Unless a bank keeps accurate record of every deposit, of every check, of every transaction, its affairs would get so tangled in a day that it would take a gang of expert accountants a month to straighten them out. To attain 100 per cent. average efficiency as to all minor units it is necessary (1) to establish standards as to them all, whether they be 100,000 or 1,000,000. (2) Constantly to correct these standards so they will always be up to date. (3) To check every actual operation against the standard. (4) To give special attention to every operation that averages below the standard until it is brought up. (5) To bring home the responsibility for every inefficiency to one or more definite persons. (6) To correct any weakness so that it will not recur.

An efficiency policy produces results more rapidly than any other. It needs neither new men nor new equipment.

It is a policy of elimination, not of expensive additions. The average is improved:

(1) By eliminating its worst elements, just as an English walnut sorter fans out the light-weight nuts.

(2) By taking hold of the remaining poor elements and boosting them up, very much as a drover lands on the laggard steers and drives them well up to the front of the herd.

(3) By accelerating the pace as to all operations.

(4) By paying special attention to dependent sequences.

The installation of efficiency.—No class of men are so strenuously worked as railroad officials. The nature of the business is such that there is no let-up even for a single hour. Strikes may occur, floods may wash away roadbeds, or snow drifts impede. Instead of these being occasions for rest and reflection they submerge the railroad official under double duty. No doubt the older generation of railroad officials thought they were competent to evolve systems of accounting in addition to running the railroads. It took several big scandals and innumerable financial collapses to show them that they needed expert accountants using accounting systems devised by independent auditors. The more modern policy in railroading is to delegate all possible activities not directly connected with railroading to outside specialists. Railroads are built by contractors, not by railroad employees; rails, locomotives, cars, bridges, are bought under contract, not homa-made. F. W. Taylor has given 25 years of his life to the study of efficiency principles and methods. His knowledge of this particular subject is probably 1,000 times greater than that of any railroad man; is, in fact, probably superior to that of all the railroad men in the United States. Railroad operation cannot, however, stop while new methods are being introduced. Neither does a railroad stop when a new bridge is put in the main line. The old bridge serves until the new one is finished. New rails are not laid over a thousand miles all on the same day. A beginning is made somewhere, and the improvement policy steadily carried out until the whole line is relaid. Efficiency methods do not begin at the top, but at the bottom. Some little unit of work in some small corner is standardized, and from this center standardization can spread as does a ripple on a water surface from the spot where a stone fell.

The small cost of increasing efficiency. —It costs to relay a road with new ties and new rails, it costs to cut down grades and straighten alinement, it costs to double track, it costs to double the capacity of cars and locomotives, it costs to secure new terminals in the great cities, but it costs relatively nothing to increase the efficiency of what is already in existence.

Some betterments involve the outlay of $1,000 in capital investment in order to save $100 of operating expense; $60 of the saving goes for interest and the other $40 is the hoped-for saving. But in efficiency work for every dollar spent on the work there should be a saving of $10. It is, in fact, doubtful whether it would cost $30,000,000 to eliminate wastes aggregating $300,000,000.

Where and with what results have efficiency methods been tried? There is only one shop in the world where Mr. Taylor's method has been fully installed. The result at this small shop was to increase output from $10,000 a month to $25,000 with a less number of men and a smaller aggregate payroll. Had there been sufficient work the capacity of the shop could have been increased to $35,000 a month with the same number of men.

There are many other instances, some of them on a tremendous scale, in which the results both in detail and in the aggregate can be studied. These methods are, for instance, being rapidly introduced into an aggregate of shops whose normal payroll is 25,000 men, and the results expected are being fully realized. One of Mr. Taylor's results was the following:

HANDLING RAW MATERIALS IN THE YARDS OF A BIG STEEL PLANT.

Records for One Year.

Amount of materials handled, tons	924,040
Total cost of handling	$30,798
Cost per ton (2.240 lbs.)	0.033
Former cost per ton	0.072
Reduction in expense	$36,418
Av'ge number of tons per man per day........	57
Former average	16

In railroad work, during a period of three years, elementary efficiency methods were applied to the account covering the maintenance of shop machinery and tools of one of the large western railroad systems. Following is a comparison of results on this road with another, parallel and competing, not having these efficiency methods.

Maintenance of Shop Machinery and Tools.

	Railroad using efficiency methods.			Railroad not using modern efficiency methods as to this account.		
Year.	Units.	Expense.*	Unit cost.	Units.	Expense.*	Unit cost
1903-4.	47,250	$487,171	$10.31	51,003	$487,150	$9.55
1904.5.	47,854	486,620	10.16	52,037	567,161	10.90
1905-6.	57,760	376,106	6.51	57,034	537,318	9.42
1906-7.	64,628	315,844	4.89	65,076	638,193	9.81

*Figures are taken from annual reports.

The second railroad simply stood pat; its expenses in proportion to work neither increased nor decreased. The first railroad took up the matter of tools in very great detail. In certain cases items that had cost as much as $6 for labor when made one at a time at some poorly equipped shop were reduced to a labor cost of 6 cents when made by the thousand on a turret lathe at a well equipped central shop.

On the same railroad some progress was made in standardizing shop practices so as to reduce the cost of repair work on locomotives coming to the shop. This was only one step in a possible dependent series of three steps: (1) Proper design; (2) proper use; (3) standardized repairs. As the newer designs did not show a lower unit cost for repairs than the older designs, and in any case constituted but a small part of the total, as locomotive average mileage did not increase, and as road conditions, owing to abnormal increase in traffic, were much more difficult, nearly the whole, if not all of the reduction was due solely to the reduced cost of each individual item of repairs.

Year.	Total weight in tons of locomotives in service.	Labor repair cost pr ton of locomotives in service.
1900-1.	61,130	$32.68
1901-2.	78,080	31.61
1902-3.	86,355	27.19
1903-4.	107,346	27.95
1900-4, average for 4 yrs	......	29.86
1904-5.	109,966	30.53
Efficiency standards were in operation in 1905-7.		
1905-6.	129,822	21.61
1906-7.	146,396	19.13

The reduction below the four year average, 1900-4 is 36 per cent.

In either writing or speaking of the results of Mr. Taylor's

methods it is difficult to make any statement that is not below what has actually been accomplished, yet the truth is so extraordinary that no one of the old school will believe it.

Average efficiency of 100 per cent. in the units reduces costs one-half. Railroads subdivide their expenditures into a very few main groups. Each main group is subdivided into classes, each class, finally through a series of subdivisions, into items. Some items could not be reduced, are perhaps already too low. Others could be reduced 75 per cent., and experience shows that on the average they can be reduced one-half. Owing, however, to the dependent sequence in which many of them stand to each other, comparatively slight reductions aggregate a very great final reduction. In a manufacturing plant where material—leather, for example—constitutes three-quarters of the expense, very little saving can be effected on the material. Railroads do not sell material, they use it. First cost is not so important as quality, design, suitability. Some ties last twice as long as others, some rails will wear twice as well as others, some locomotives are maintained for half the expense of other locomotives of the same weight in similar service.

The difference on the same railroad between the best and the worst as to identical units is always more than two to one, is in fact more nearly four to one. On a certain road the costs of moving 1,000 ton-miles of freight train load varied as follows:

Best division	$0.29
Average of all divisions	0.51
Worst division	2.67

The cost of repairs to freight engines per ton of locomotive fuel used varied as follows:

	Per ton of fuel	
	Cost of repairs.	Ton-miles of frt. train.
Best division	$0.78	9,300
Average all divisions	1.25	7,750
Worst division	2.25	9,900

Both best and worst divisions were dead levels, as to grades.

Cost of locomotive supplies per mile weight unit of locomotive:

Best division	$0.70
Average of all divisions	1.40
Worst division	2.50

Both best and poorest divisions were main through lines without branches, both had the same types of locomotives, both were water-level grades.

The foregoing very great variations occurred, not in individual locomotives on their best record runs, but as to the whole service for a whole year for a whole division. The best performance on each division was at least twice as good as its average performance for identically the same unit. Similar variations exist on all roads in the United States, and those who have studied unit costs consider it a rather elementary proposition to bring the average up to the level of the present best, since the present best rarely shows a higher efficiency than 60 per cent. of the ideal.

Losses to American railroads.—The *Railway Age* of May 15, 1908, p. 687, states that the losses in revenue to American railroads in the present calendar year may aggregate $300,000,000. The total dividends paid in in last fiscal year were about $275,000,000. The preventable losses and wastes occurring on American railroads in the last calendar year were about $300,000,000.

Shall dividends be curtailed?
Shall wages be reduced?
Shall prices of materials be reduced?
Shall necessary maintenance be postponed and neglected?
Shall freight rates be raised?
Shall unnecessary losses be eliminated?

The elimination of unnecessary losses and wastes does not involve a lowering of wages nor a decrease in the unit cost of materials nor the ultimately very expensive neglect of necessary maintenance. It will mean that fewer men will be employed than now but they will be of higher grade and receive a higher average rate of wages. In the last few months about 500,000 unskilled, day-labor foreigners returned to their own countries. There is no reason why the United States should be made attractive to this kind of immigrant, and it would not hurt us if another 500,000 went home. Economies in labor would be largely in this class, not in the skilled man.

Less material would be bought, but it would be of higher grade. Conventions are being held now to protest against the lavish waste of our irreplaceable natural resources. Even if it may come a little hard on some lines of industry it will be a great national blessing if less coal is used to accomplish the same work, if fewer ties are necessary, if rails do not wear out so fast, if locomotives and cars last longer and are more efficiently used.

Dividends may have to be reduced, but those who suffer the reduction will consider it a national calamity.

Wages may have to be reduced, but those who suffer the reduction will also consider it a national calamity.

Freight rates may have to be raised, but there will be protests and struggles against the increases.

Even, if in their present straits, railroads resort to other remedies, why should they not all take up this subject of current inefficiencies, carefully, scientifically, thoroughly?

The discovery of a little gold deposit up on the Yukon in northwestern Canada startled the whole United States and more than any other single cause broke the lingering depression which began in 1893 and was still in full sway even after the election of McKinley in 1896. This gold production was scarcely $12,000,000 a year. The total gold production of the world, to which the marvelous era of the last 10 years of prosperity has been ascribed, is only $400,000,000 a year, and it costs perhaps $300,000,000 to get it out. What would not a saving of $300,000,000 a year in American railroading do for the railroads and for the people as a whole?

Exhibits at the General Foremen's Convention.

At the second annual meeting of the International Railway General Foremen's Association, held at the Lexington Hotel, Chicago, last week, beginning May 25, the following concerns had exhibits:

S. F. Bowser & Co., Fort Wayne, Ind.—Bowser self-measuring oil pump and tank

Celfor Tool Co., Chicago.—High-speed tools, drills and reamers.

Chicago Railway Equipment Co., Chicago.—"Creco" brake-beam, latest type, meeting M. C. B. requirements.

A. C. Clark, & Co., Grand Crossing (Chicago), Ill.—Clark mechanical boiler cleaner.

Commonwealth Steel Co., St. Louis, Mo.—Models of cast-steel one-piece tender, frames, transom draft gear for wood and steel underframe freight cars and engine tenders, steel bumper beam and Davis counterbalanced driving wheel.

Detroit Lubricator Co., Detroit, Mich.—Detroit No. 2 lubricator with new air pump cylinder feed attached; visible sight-feed guide cup.

Farlow Draft Gear Co., Baltimore, Md.—Farlow draft gear.

The Walter H. Foster Co., New York.—Samples of work from the Lassiter bolt turning and threading machines.

Firth-Sterling Steel Co., Chicago.—Samples of blue chip high-speed tool steel.

Garlock Packing Co., Palmyra, N. Y.—Samples of Garlock locomotive and shop packings.

Gold Car Heating & Lighting Co., New York.—Couplers and reducing valves.

Goldschmidt Thermit Co., New York.—Butt welding of wrought iron and steel pipes and rods; application of "Thermit" in foundry practice; samples of locomotive frame welding and fire brick molds for same; compromise rail weld for electric railway work.

Hunt-Spiller Manufacturing Corporation, Boston, Mass.—Gun iron for cylinder packing and cylinder bushings, driving boxes, shoes and wedges, eccentrics and eccentric straps.

Jenkins Bros., New York.—Samples of valves.

Landis Tool Co., Waynesboro, Pa.—Catalogues of general lines of grinding machinery in use in railroad shop.

Nathan Manufacturing Co., New York.—Injectors, lubricators, pop valves, Klinger reflex water gage.

National Patent Holding Co., Chicago.—National case hardening compound; National hot water locomotive boiler washing system; National never-slip boiler plate clamp; evaporating blow-off valve.

Pyle-National Electric Headlight Co., Chicago.—Electric headlights.

Safety Car Heating & Lighting Co., New York.—Pintsch light in connection with mantles which produce a perfectly incandescent light of 100 candlepower.

Scullin-Gallagher Iron & Steel Co., St. Louis, Mo.—"Excel" car coupler.

Spear & Miller Railway Supply Co., Chicago.—Samples of brake-shoes.

Storrs Mica Co., Owego, N. Y.—Mica chimney with mantle attached.

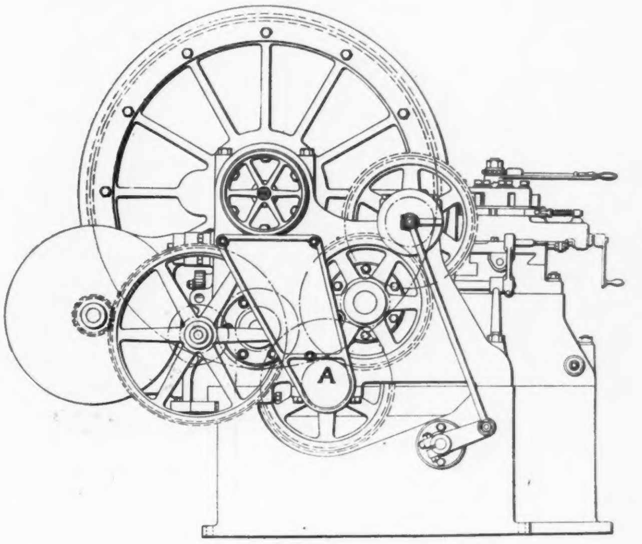
Zephon Chemical Compound Co., Chicago.—Samples of scale removed from boilers by Zephon boiler compounds.

Some two or three years ago there was serious talk of pooling the entire rolling stock of all the different state railroads of Germany, including locomotives and passenger cars as well as freight cars. The obstacles to this were so great that no agreement was made; but the movement, now limited to freight cars, has been resumed, several of the smaller states are said to be ready to unite with the Prussians, who have already one control for their vast system; and it is thought that if an agreement can be reached as to the payment for cars when run on foreign lines, the other states will come in; but it is not expected that this can be concluded very soon.

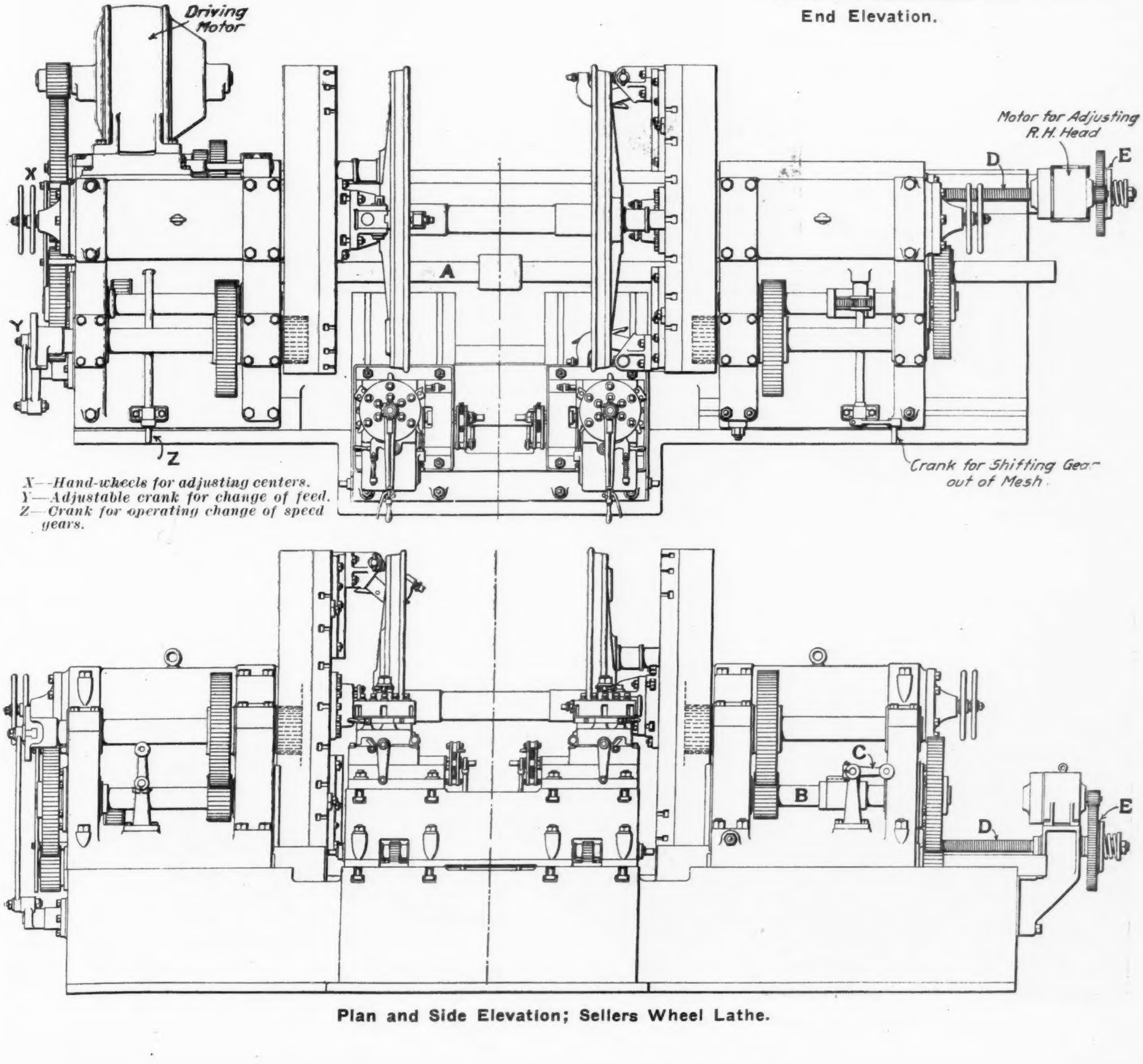
The Sellers' Driving Wheel Lathe.

Ever since the advent of high-speed steel, makers of machine tools have been trying to raise their capacity up to the cutting possibilities of the steel. The result is that the machine of the present day is far better than its predecessor in every respect, and the time required for a given piece of work has been shortened to a point far below what would have been considered possible a few years ago. This is especially true where large quantities of metal have to be removed, as in the turning of car and locomotive wheels where treads have become worn and distorted by the rolling out of the metal. In designing the wheel lathe recently brought out by the William Sellers Co., Philadelphia, Pa., the principal aim was to make a machine with power and capacity to remove the maximum amount of metal that the cutting tools could handle and at the same time leave so little to the operator that the machine could be run at full capacity during the full working day, and keep it up day after day. It may be noted here that the output made during demonstrations is seldom maintained throughout the day's work, and that high records of output are usually at the expense of a man's endurance. Where driving wheels are turned rapidly, and an attempt is made to maintain that rate day after day, the mere labor of handling the heavy tools, changing them and fastening them in the tool posts, requires such physical exertion that the operator is exhausted at the end of the day. In the lathe under consideration, an effort has been made to minimize this labor, by means which will be described later in detail.

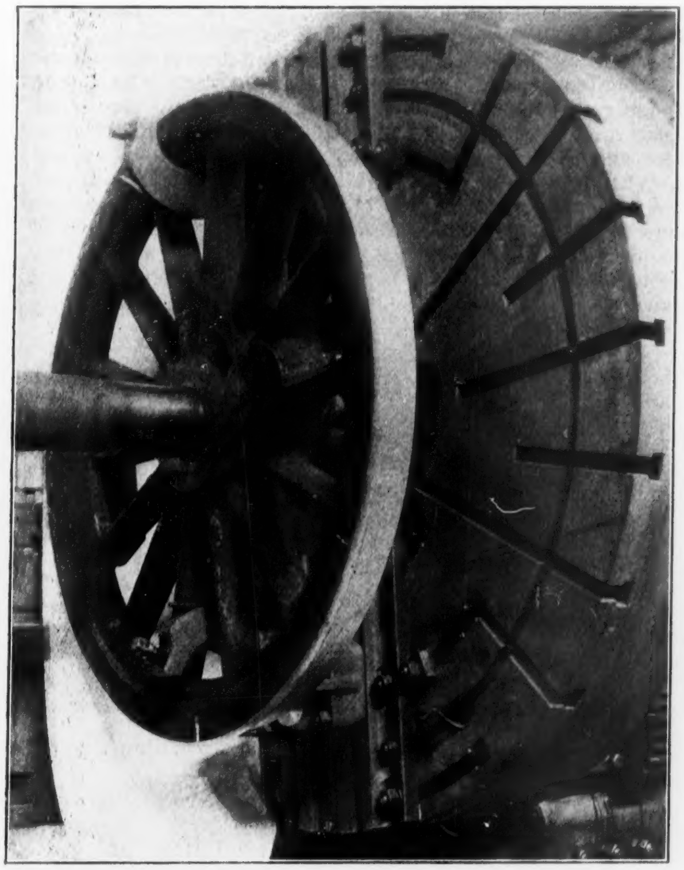
The lathe will readily take a cut ½ in. deep, with a feed of ½ in., in the ordinary steel used in the tires of locomotive drivers, on wheels of 84 in. in diameter when worked in the



End Elevation.



Plan and Side Elevation; Sellers Wheel Lathe.



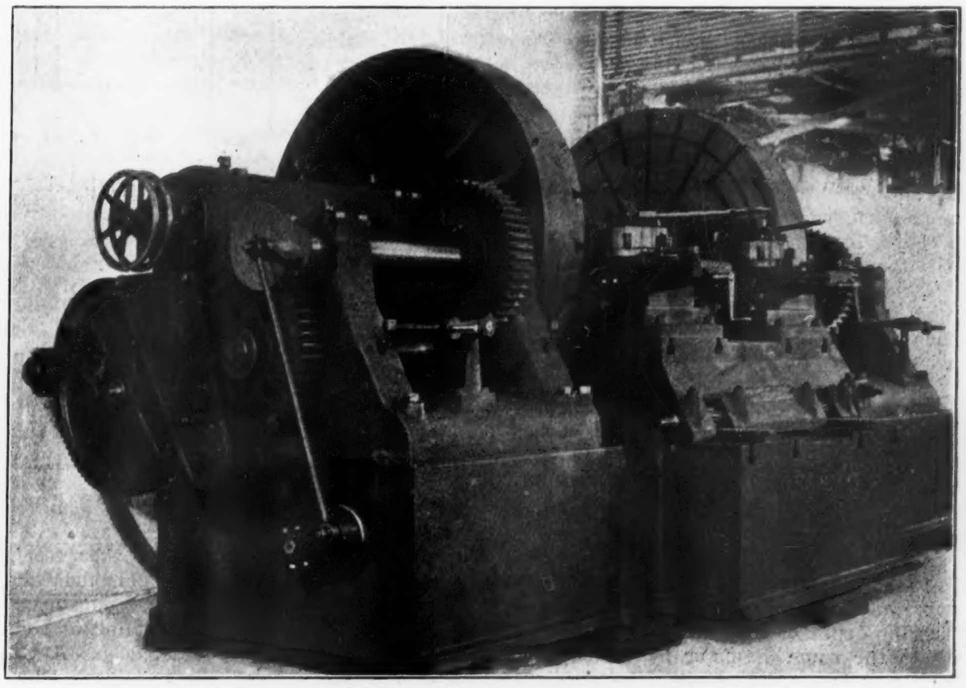
Wheel Set and Held by Dogs.

ance. This clutch is simple, consisting merely of a tapered disc fitting into a corresponding ring cut in the body of the spur gear of the drive and held in place by the strong helical spring shown on the end of the screw shaft. The spring is put on under a tension of about 9,000 lbs. and makes enough friction to drive the screw when there is no resistance beyond that of the sliding of the head on the bed. But when the head is run forward and the centers bottom in the axle, the clutch slips and thus automatically protects the teeth of the gear from breakage, though still insuring a solid contact between the spindle and the axle. The head is carried on flat ways and is guided by gibs set on one side, by which alinement can be made. It lips under the bed at the back, so that provision is made for thrusts in every direction. It is held down by inverted T headed bolts, whose heads slide in grooves cut in the base as in the ordinary planer platen. Those at the front, or operating, side are tightened by nuts at their upper ends, turned by a wrench. As those at the back are inaccessible, they are enlarged in their shanks and have a slot cut through them in which a long wedge is placed. The stem of this wedge, which is $2\frac{1}{8}$ in. wide, extends forward to the front side, where it is worked by nuts put on the thread cut on it. These nuts are on either side of a lug so that one is used for tightening and the other for slackening the wedge. In this way the workman is prevented from driving it back with a hammer and thus marring the end.

In placing the wheels, the centers are so adjusted in relation to the face of the center plates that they will hold the tires at the proper distance therefrom. The left-hand head is then run back and the wheels swing into place so that the crank pins will enter the proper openings. The head is then run in until the friction clutch slips, when the centers will have bottomed and the wheels be held fast.

Reference has already been made to the fact that to get steady drive the old method of placing the dogs against the spokes has been discarded and the drive moved out against the rim or tire. To do this, a modification of the old knuckle joint planer dog is used. The face plates are specially grooved according to the number of spokes in the wheels and the position relatively to the crank boss. Thus grooves must be made for an odd and even number of spokes, with the crankpin centered with a spoke or between two spokes; therefore provision has to be made for four combinations of wheel constructions. The face plates are grooved accordingly and marked so that the workman, when preparing to turn a pair of wheels, is not obliged to make any calculations as to the location of the bracket casting that holds the dog, other than to note the relative position of the crank and spokes and the number of the latter. The dog itself is an interesting adaptation of an old idea to a new purpose and is shown in some detail in the accompanying engravings. It is bolted to the bracket that is fastened to the face plate, as just described, by a bracket of its own. The latter carries, in an oblong hole, a pin on which the dog proper is carried. The main part of the dog has a gripping shoe *a* and the pivoted arm has a set screw *b*. The arm swings up between the spokes of the wheel and the two grips come in line with the two faces of the tire. The set screw *b* is then turned in with a heavy wrench until its point has penetrated the metal and the shoe *a* has a firm grip. This shoe *a* is held in line and in place by the sides of the holding bracket, but the set screw *b* has a slight swinging motion. When the lathe is started, the shoe *a* drives the wheel through the tire, but if there should be any slip the set screw *b* hangs back with the tire and in so doing gets out of alinement with *a*. The slotted hole in the dog makes this possible, and, as this lessens the distance between *a* and *b*, the former is drawn into the metal of the tire, tightening its grip. When this grip exceeds the thrust of the tool, the tire will turn and the cutting proceed.

We now come to the carriages and tool ports for holding the tools. Here there is a decided innovation. The old tool port, requiring the removal of the tool and the bolting down of another with a heavy wrench whenever a different tool was to be used, has been discarded and the turret substituted. This turret is carried on the carriage, having the usual longitudinal and cross feeds; the former is driven by oscillating

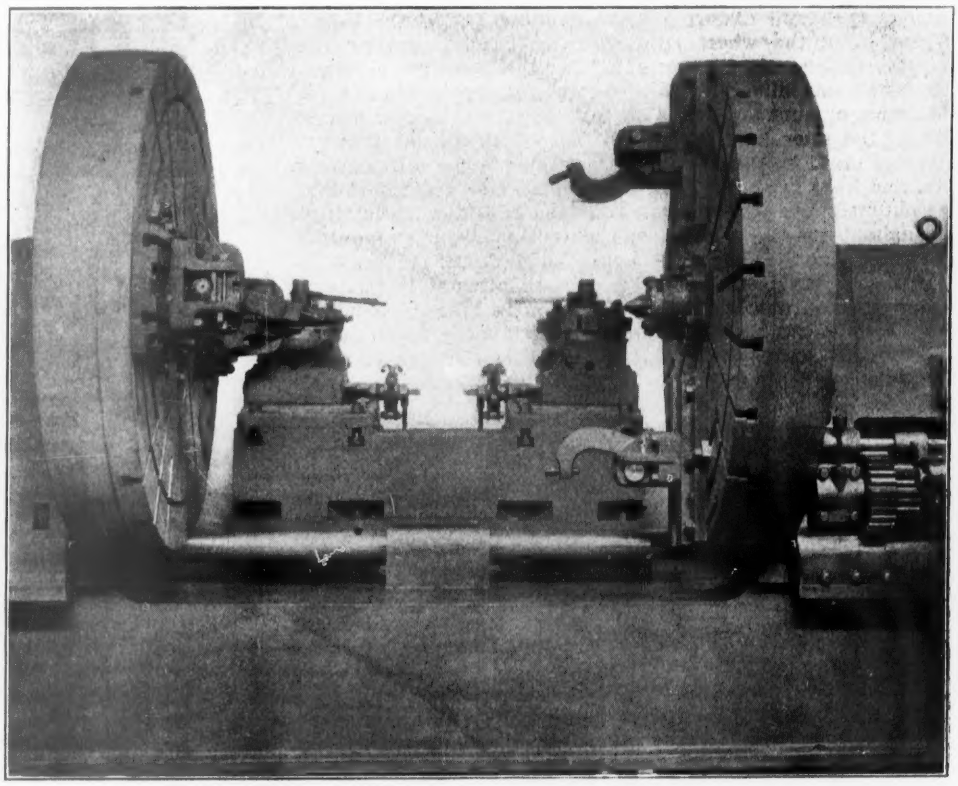


View Showing Turrets and Driving Gearing; Sellers Wheel Lathe.

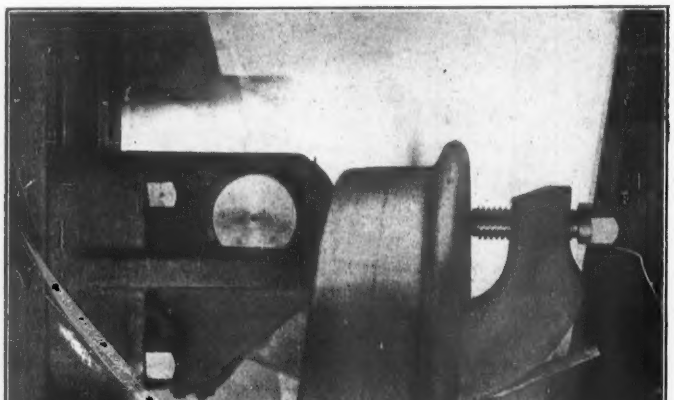
lathe of 90-in. swing. It is estimated that when the tool is cutting ⅝ in. deep with a ½ in. feed, the pressure at the point is about 55,000 lbs. Such a cut is readily made at a speed of 16 ft. per minute, which requires 880,000 ft.-lbs. per minute, or nearly 27 h.p. at the point of the tool. To do this and, at the same time, avoid chattering, necessitates not only heavy construction in the machine itself, but a system of drive that is absolutely rigid, when referred to the point of attack. This cannot be the case where the drive is attached to the spokes, for then there is always more or less yield, and this means a chatter. To get the best results, the drive must be moved still further out and attached to the tire itself, as is done in this lathe. Further than this, all stresses must be removed from the axle and the face plates must be as rigid as it is possible to make them; at the same time they must be close to the wheel so as to lessen the spring or yield that would otherwise take place in the dogs used for driving. It will be conceded that these are all points of importance, and in working them out in the design of this wheel lathe many new and original ideas have been developed. Starting with the bed and the head stock, the design, as will be seen from the illustrations, is exceedingly strong and heavy. The metal of the ribs and shell is 1¼ in. thick, the total length is 23 ft. 2¾ in., and total width 7 ft. 10½ in., 8 ft. 3½ in., or 8 ft. 8½ in., accordingly as the swing is 80 in., 90 in. or 100 in.

The machine is driven by a Westinghouse variable speed No. 12 type S 50 h.p. motor, set on a bracket at one side of the head stock. The motor runs at 500 r.p.m. It drives the main shaft A, through a train of reducing gears, and from this shaft the power is applied to the rim of the face plate at either end by a similar train. It will be noticed that the pinion meshes with the face plate on the front next to the tool, whereby the stress on the spindle is much less than would be the case were the drive at the other, or back, side or at the bottom. For example, if the drive is at the back, the thrust of the pinion tends to lift the face plate and the tool tends to do the same. If they are both at the same distance from the center and the lathe is working so that the pressure on the tool is 55,000 lbs., then the pressure at the pinion must be the same, and there will be a lift on the spindle of 110,000 lbs. With the drive at the front, as in this lathe, the two forces balance each other and no stress whatever is put on the spindle other than that of carrying its own weight and that of the face plate.

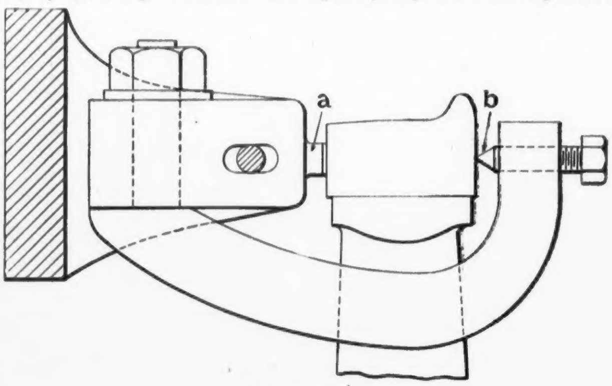
The face plate is of cast iron with the cut gear bolted to the hood at the back. The centers for carrying the wheels are made with an angle of 60 deg., ¼ in. of the point being cut off so as not to mar the work. The center is moved in and out by the outer of the two handwheels shown at the end of the spindle, the other serving merely as a check nut to hold the first in position. To protect this center spindle from the effects of wear, it is made to pass through a bushing at the front end that is let into a gland-shaped casting bolted to the face plate. This bushing is tapered on the outside and is split, so that, when it is drawn in by its fastening bolts, its internal diameter is contracted and it can be made to fit the spindle and thus take up any lost motion that may be occasioned by wear. To adjust the face plates for use with engines having the left or right-hand crank leading, the pinion of the back gear at B can be moved longitudinally, together with its shaft, by the crank handle C, until it is out of mesh, then, by turning the other face plate, any desired adjustment can be made. For readily handling wheels and axles in and out of the machine, the right-hand, or tail, head can be loosened from the bed and moved to and fro by a screw driven by an electric motor, as shown on the engraving. This motor drives the screw D through a friction clutch E, which is adjusted to slip when the head encounters some solid resist-



Face Plates with Driving Dogs in Position; Sellers Wheel Lathe.



Dog in Position.



Driving Dog.

the work four minutes. This work was done at a cutting speed of from 13 to 15 ft. per minute, and when a tool steel is produced that can withstand the heat and stress of a higher speed the performance of the machine can be correspondingly increased.

The lathe is built to the following specifications:

Effective range of wheel diameters, 48 in. to 87 in.
Maximum diameter that will swing clear, 90 in.
Diameter of face plate, 90 in.
Maximum distance between face plates, 10 ft. 6 in.
Gear changes, from 1 to 2.
Variation of motor speeds, from 1 to 2.
Speed of face plate, 0.375 to 1.5 revolutions per minute.
Driving motor, Westinghouse, 50 h. p. at 500 revolutions per minute.
Ten feeds, from 0.055 to 0.492 per revolution.
Feed strokes per revolution face plate, 7.
Turning-bench adjustable in and out by racks and pinions.

Railroad Cost Accounting.

BY S. M. HUDSON,
Auditor, Fort Worth & Denver City.

I.

A METHOD OF DIVIDING PASSENGER AND FREIGHT.

The editorial on Railway Cost Accounting in the *Railway Age* of March 6 was extremely timely. Courts and commissions are calling for "Cost" and basing their decisions on guesses at it, and if the railroads do not put into effect a proper system of cost accounting backed by right reasoning, they may rest assured some one else will formulate a system for them, possibly to their great loss. Cost as a basis for judging reasonableness of rates may be improper, for if rates must produce cost and return on capital, why should the corporation strive to reduce cost and increase the efficiency of capital if there is no reward? Yet we must recognize facts, and the fact is that, right or wrong, courts and commissions do base their decisions very largely on costs.

It is useless to say it cannot be done. It must be done, and I believe a following of the well recognized principles of philosophic generalization and analysis will develop a true and just method which in its results will reflect the varying conditions under which the different kinds of traffic are handled. All expenses (cost) must be met out of the rate, and surely there must be some reason why a specific amount of those expenses should be assigned to each kind of traffic; reason that will satisfy intelligent investigators because based on known just principles of universal application.

In the Passenger Rate Case, decided against the St. Paul by the Wisconsin commission, the commission threw out some charges against Wisconsin traffic without stopping to ascertain whether other states would accept them as additions to their proportion. It also transferred some charges from passenger to freight without stopping to consider what would be the effect on freight returns.

Wisconsin attacks the passenger rate, Minnesota some freight rates and South Dakota some others, and each has been or will be decided without regard to the total result. Such a condition should not and would not exist if the railroads had taken proper action and had prepared themselves to show up their whole business properly divided.

A proper and just system of cost accounting should be developed, and then when any rate question comes up, full analysis of the whole situation should be made, dividing between states, then in each state between freight and passenger, then in each of these between state and interstate traffic. If the method adopted has truth as a basis it will apply to all lines and all business, and will surely reflect in the results developed the varying necessities and inequalities of the different classes of traffic and the operating disadvantages of the different roads.

In the editorial, reference is made to an article by Professor Robinson in the *Yale Review* which treats somewhat of the subject, though apparently written more for the purpose of outlining the present situation of government authority over rates as gathered from Supreme Court decisions, showing how much cost was at the base of these decisions, and showing how little there is in railroad accounts to show cost, with a further final inference that courts should appoint commissions to get at the facts which are necessary to be known before a true decision can be reached.

In the discussions, Professor Robinson refers us to four methods: the Pennsylvania, the St. Paul, the Woodlock and the Wisconsin commission, explaining each somewhat and pointing out the great difference in results obtained. The results on the St. Paul railroad's state passenger business with expenses divided on the basis of Pennsylvania's method produced a loss of $513,352, while on the basis of the Wisconsin commission method it showed a gain of $359,233.

The Pennsylvania's method has received an endorsement by a court, one thoroughly trained in the application of general principles to all kinds of business, while the commission's method has not yet been reviewed. Can it be possible that the court which decided for the Pennsylvania Railroad could have made so tremendous a mistake in fundamentals? For these different results reflect methods, and methods only. While Professor Robinson shows four methods, there are in fact only two, the Pennsylvania and the Woodlock; St. Paul's being a modification of Pennsylvania's and the commission's, being a modification of Woodlock's.

The Woodlock method is based on an attempt to find some direct connection between final results of production and the indirect or common expenses and apportion these expenses on the nearest work unit: this is a grubbing in detail which is not necessarily scientific.

The Pennsylvania method is more scientific in that it attempts to divide the common expenses on the general principle of use, but gives to this principle too wide an application, nearly all common cost being apportioned on the train mile.

The Wisconsin commission followed Woodlock in the main, the only deviation being a more unjust and illogical extension of his method, and it uses as bases of divisions revenue train miles, gross earnings, engine miles, engines owned, coal used, average train mile cost of direct expense, and explains its method of reasoning by saying: "An effort will therefore be made to apportion the common items (indirect expense) on that particular item or items of the direct costs or on that unit of service to which they appear to bear the closest relation."

How wrong the commission can be in its reasoning against a unit is shown in the following quotation in regard to the use of the train mile: "Whether this method is fair depends entirely upon whether the two classes of mileage, mile for mile, represent the same thing. If the passenger train mile costs as much as the freight train mile; if the direct outlays in both cases are the same, then this mileage may be a safe and fair basis upon which to apportion the indirect or common expenses between the two classes of traffic. If, on the other hand, the direct outlays per train mile are much greater in the one case than in the other, then it would certainly seem unfair to so distribute the common expenses that they would be shared equally per train mile by both classes of traffic." Yet neither the costs nor the units produced are the same. Why? Can this have anything to do with costs incurred for the business as a whole?

In truth and reason, whether train miles shall be used or not and, if used, to what extent, does not depend on the direct cost of the various kinds of train miles or have any relation to it.

Say there are four machines, each occupying one-fourth of the floor space in a room the rent of which is $100 per month. The direct costs of running these machines, for service, power and supplies per day are $15, $10, $5 and $2.50, yet the rent chargeable against the output of each machine is $25 per month, based on floor space used, and no one would dream of apportioning this rent on cost of operating, units of output or gross receipts. That machine would make the best returns on rent paid that most efficiently utilized the space paid for.

The error arises from attempting to reason from the direct cost to the indirect through analogy and relation of units of work, instead of recognizing direct cost as "cost" and the common expenses as fixed charges assignable on reasons of broader scope; we need first to find why these expenses arise, and from the nature of that "why" deduce our principle of distribution.

In justice we should note that Woodlock was endeavoring to develop a ready method for approximating cost for the use of those who did not have access to railroad accounts. And,

cranks and the latter set in by hand. In the longitudinal feed, there are six or seven impulses per revolution, according to the size of the wheel, with a range of from 0.055 in. to 0.492 in. on the 90-in. lathe, and from 0.047 in. to 0.47 in. on the 80-in. This is done by a dog and ratchet of the usual type. It is of course necessary that the turret should be of the most substantial description, that it be perfectly rigid when at work, and yet be easily and quickly released and turned for each change of tool. In the first place, it has a broad base resting on the carriage and the rotating part is fastened to this base by a bolt 3 in. in diameter. This bolt, the head of which is countersunk in the base, passes up through the turret, having a slotted hole on the tool line for the passage of the roughing tool, and is held by a nut at the upper end. It must turn with the turret, and so it has no tendency to loosen. The face of the turret has six notches with which a dog enters to hold the turret in proper position for the use of each tool, there being as many notches as tools. At the top of the bolt there is a collar with notches to catch the latch of the adjusting lever, which is of the same character as the throttle or reverse lever of a locomotive. This lever is pivoted on the bolt. Its lower surface is cam-shaped and rests on a loose collar, having a V section, that fits in between a flare of the holding bolt and the top plate of the turret. When the holding dog is pulled out and the lever latch is in the collar, the turret can be turned. By catching the dog in place and pulling on the lever, the cam presses up on the lever, draws

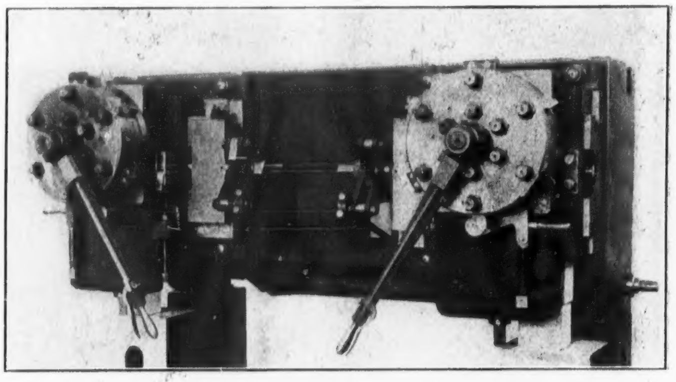
Bench with Turrets in Position.

on the bolt and tightens the whole so that it is immovable. By this means, the turret can be easily and rapidly turned and the successive tools brought into action.

The tools are held in place by 1¼-in. tap bolts passing through the top plate of the turret. There are four in all. First there is the roughing tool, which is cut from a straight bar and extends entirely through the turret; next comes the flange former, which is put down on the flange and cuts it to shape, leaving about 1/32 in. to be taken off by the finishing tool; then the flange finishing tool, which puts the final finish on the flange and about 2 in. of the tread; and, finally, the tread tool, for the outer edge and corner. The roughing tool alone is fed by the regular lathe feed; the others are run directly in by hand and are all worked out to shape.

In adjusting the tools to position, a gage is made to set over dowels in the top plate of the turret and drop down in front of the nose of the tool. The tool is then run out against this gage and clamped. A similar gage on the other turret makes it possible to set both tools in exactly the same position. On the side of the turret, as shown in the engraving, there is another hinged gage with a screw facing it. This screw has a micrometer adjustment with a coarse scale alongside. The screws on both sides are then run up against this gage, or stop, and then withdrawn the same amount. This withdrawal fixes the depth of the cut, so that the two wheels are roughed out to the same diameter by moving the tool forward until the screw is in contact with the stop. By this arrangement, the roughing tools can be replaced at any time to exactly the same position, should breakage or dulling necessitate the removal of the one in use.

By turning the stop gage at the side of the turret back the finishing tools can be run in to any desired point. The method of doing the work is to first take a roughing cut across the tread, and then withdraw the tool and put a block 1⅛ in. thick against the face of the stop and run the tool up against it. This practically withdraws the tool by that amount and sets it for turning off the top of the flange. This having been done, the flange former is run in until it cuts at the top of the flange. Then the flange finishing tool is run in until the tread finishing portion is cutting at the bottom of the cut made by the roughing tool. Finally, the tread tool is run

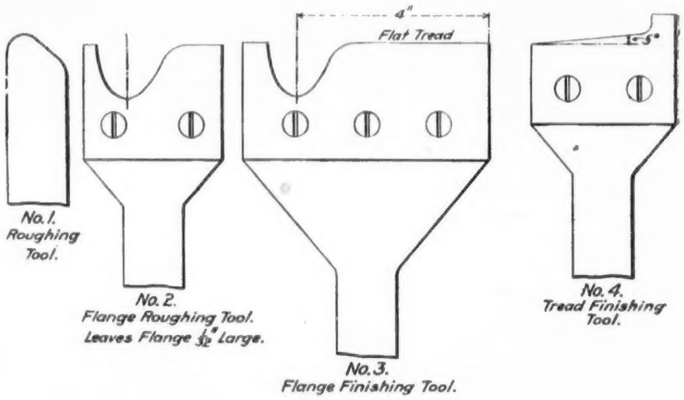


Top View of Turrets, Showing Locks and Turning Levers.

down to the same point and after one further revolution of the wheel the work is completed.

In testing this lathe, up to the present time the cutting has been limited to a speed of about 13 ft. per minute with a cut and feed of ½ in. The lathe, however, is quite capable of removing the same amount of metal at a speed of 25 ft. per minute. The reason why this is not done is that no tool steel has yet been produced to stand the strain and the heat. As it is, with a ⅜-in. cut and a ½-in. feed the tool and the metal it is cutting is at a red heat at the point of contact.

As for the speed with which work can be done by this machine a demonstration was recently made in which the lathe was set complete for turning wheels of 78 in. diameter with



Tools for Turning Tires; Sellers Wheel Lathe.

6¼ in. tires in 12 minutes, including the placing of the wheels in position for work. They were then finished complete in 19 minutes and placed on the floor in four minutes more. The total time, then, from floor to floor, including the setting of the lathe, was 35 minutes. This work was the same as the turning off of a new set of tires and the cut was but ⅛ in. deep. In another test, a pair of 67-in. wheels with 6¼-in. tires were chucked in seven minutes, turned complete in 28 minutes, and put on the floor in three minutes more, or a total of 38 minutes from floor to floor. In this case the cut was ⅜ in. deep. A third test was also with 67 in. wheels and 6¼ in. tires. They were chucked in nine minutes and finished in 43 minutes, the breaking of a tool having delayed

however much we may question the reasoning of the Wisconsin commission method, the opinion shows evidence of most careful, conscientious study of the subject, and will repay one for the time spent who will give it the study it deserves.

We will leave for the present the division of expenses between states, assuming that to have been made, and proceed to the discussion of a method of dividing between passenger and freight. We should note, however, the great importance of this question of division between states, for unless united action can be had looking to an agreement with state commissions as to correct principles to be applied, we are liable to have some expenses of operation, maintenance and capital repudiated and it would probably be difficult to get the question before a court of sufficiently wide jurisdiction to make a decision binding through all parts of a great system.

Looking at transportation as a product, we see that the units of product are produced under varying conditions arising from the nature of the traffic, leaving out of consideration all difficulties in the development of the plant itself.

In freight the first unit is the shipment, and shipments differ widely in relation of weight to bulk and the consequent amount of dead weight (carriage) required; they differ in weight per shipment; in distance to be hauled; and, considered as a whole, whether freight moves equally in both directions, is constant and approaches the full capacity of the plant. Yet in the freight business we can adjust our direct expense of train cost to the amount of business.

In the passenger business the product is the passenger one mile, and this grows out of the first unit, the passenger multiplied by the distance; the density, approximated, gives us the number of trains we should run and these trains must run at regular intervals whether full or not; having once established the amount of passenger facilities to be offered, our direct train cost is constant whether utilized or not.

It is evident that under such conditions direct cost per unit cannot be uniform, in fact to arbitrarily assume it to be so would be contrary to reason; would be ignoring known causes of cost.

The first thing necessary is to classify our expenses.

Looking at the corporation which is doing the producing, it is evident that its expenses fall under two heads only, heads which are distinct and which may well be governed by different principles. One is expense of plant (maintenance), the other, expense of production (operation). Under the system of accounts promulgated by the interstate commission, there is a third, general expense, but that is only a common expense of the other two. The object of this general expense, with all its recording and supervision, is to maintain the property, make it produce, and preserve the corporate life; yet that corporate life has its sole expression in maintenance and production; so that the whole of what is known as general expense has for its objective these two results only. In apportioning general expense the reasoning is clear and direct. Maintenance and production being so dependent upon each other, and of equal importance each to each, their common expense can only be assigned on the basis of 50 per cent. to each, and having done so we have only the two classes of expense to consider in the first generalization.

Let us here call attention to a grievous error in regard to another class of expenditure. Under our new system, cost of hiring other capital, that is equipment, track and terminals, is now charged to income where it was formerly charged to expenses, and under usual methods this cost is divided on "actual when possible" or on a train mileage basis. No matter where placed in the accounts, the expense has to be met out of revenue and must be divided.

The proper reasoning would seem to be that each class of output of the corporation is entitled to its *pro rata* share of the capital of the corporation and should stand its *pro rata* of any additional capital hired. The general method, for example, is to charge hire of passenger station to the passenger business, but the freight should stand its *pro rata*, the passenger business is not responsible for the assignment of capital.

A road thought to be fully equipped finds it necessary to hire ten engines temporarily; the management can use them in either service. Is that a sound method of division which would make the assignment of this cost depend on the arbitrary decision of the management? It therefore seems as if hire of additional capital were an indirect or common cost, following in its nature the maintenance of plant, and assignable on the same basis.

We have under the general term of maintenance two divisions: maintenance of equipment and maintenance of the fixed portion of the plant called roadway and structures.

Under head of equipment, expenses are directly assignable, for equipment is either built specially for the freight or passenger, or, as in case of engines, is specifically assigned to each class of service, hence here then is no difficulty; but under the head of equipment accounts are found cost of supervision, cost of maintaining shop machinery, and production of light and power in shops. These items of cost being incurred for producing repairs on freight, passenger and work equipment are logically apportioned on their product which is best measured by the amount of money in labor and material expended in these repairs. The work-equipment proportion is transferred to maintenance of way.

Taking up maintenance of way accounts, we have: regular maintenance of way and structures accounts; 50 per cent. of general expense; proportion of supervision, etc., of work equipment; cost of hired capital; making up the total of the maintenance costs which are common, and must be assigned between the two classes of traffic.

All these expenses are for the one object of having a plant in complete order and capable of producing; and the track, the point of contact, is that around which all interests center. It is not necessary to calculate scientifically the relative attrition of the dust raised by the fast passenger train and the slow freight train on the barbed wire right of way fence, or to hunt for some connection between the ton and passenger mile and the disappearing paint on the shanty of the crossing watchman. The plant is maintained for use and that use is chargeable with the cost on basis of units of use.

Theoretically at least, we do not have two trains occupying the same piece of track at the same time, and to the extent that a train of certain traffic does occupy a certain piece of track, to that extent the train and its traffic are responsible for all that is involved in the supervision and maintenance of the track and its necessary appurtenances, and this is true without regard to the productivity of the train.

It has always been the contention of the railroads that some classes of business occupy the plant while giving little opportunity for production of final units, others produce very largely with only same amount of use: that the waste of the one is not chargeable to the other; that persons desiring wasteful traffic should pay for its higher costs in higher rates. This idea has been recognized in many ways in tariffs. It is very well shown in rates when business is only one way, with its expense of empty return haul.

The elemental unit of use is the passage of the train over one mile of line; that is partially represented by the revenue train mile; but to get full use every movement should be counted. An engine and caboose going back for a load is an uneconomical freight train; so too, is a return from helping; a freight train handled by two engines is a productive use, and one handled by a single large engine is still better. Shifting of power for the benefit of any traffic is chargeable to that traffic, not only for direct cost but for indirect also. Outsiders may talk very glibly, but putting on another train does not mean simply paying the train and engine crews and buying the necessary coal.

We would then divide these common expenses on the basis of the train mile, including in the count every movement, not revenue trains alone. I believe this to be a true and just basis; one backed by sound reason; one that allows differences in conditions of traffic to manifest themselves.

Cost of Production.—As in maintenance, we have both direct and indirect, or common, costs.

Among the direct costs are train and engine service and supplies; at places separate freight and passenger agents and clerks, responsibility for wrecks, loss and damage, etc.; on some lines separate supervision by traffic departments, switching service and expense.

Among the indirect we have 50 per cent. of general expenses, transportation supervision, terminal expense, and on some lines joint traffic supervision.

These should be divided on the product units out of which

grow the units of production. These product units are the shipment and the passenger. Shipments and passengers are handled and supervised, so far as cost is concerned, without regard to weight or distance in the first or distance in the latter.

Using the relative number of shipments and passengers as a basis, we have a uniform cost for each of these units, to be eventually distributed among the final units of production, ton miles and passenger miles, as they are developed from the traffic itself. These expenses are incurred equally for some unit without regard to its productivity, and its further productiveness is not dependent upon this class of expenses. The method outlined above of apportioning common expense is not difficult or costly to apply, most of the work being already done or capable of development from records now made in accounting departments. But its merits, if it has any, depend on the truth of the following propositions:

Expenses should be classified as two only, those of maintenance and those of production, as deduced from the nature of the corporation and the object of its existence.

Deficiency of capital is a common expense following in its nature the expense of maintenance of plant.

General expense is a common expense divided equally between maintenance and production on the ground of their equality in importance.

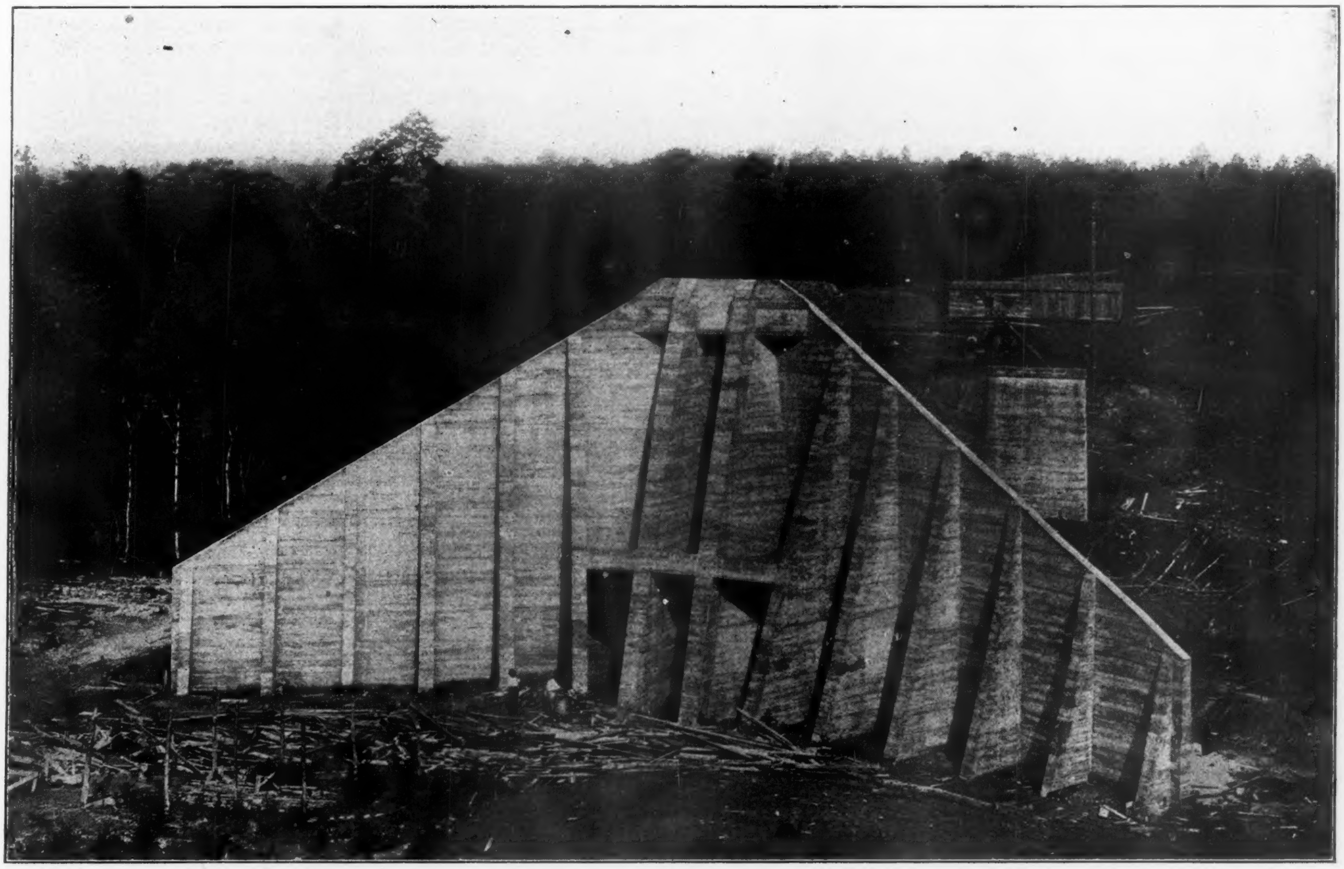
Common maintenance costs are assignable on basis of use alone (train miles) the effectiveness of that use not being a factor in the assignment of that class of costs; in fact, the exclusion of the question of effectiveness may well be considered an elemental necessity for proper solution of the problem.

The common transportation costs of production are assignable on the product unit basis (shipments and passengers) as being the broadest unit and one allowing full expression to the varying conditions under which ultimate product is obtained.

(*To be continued.*)

Reinforced Concrete Work on the Atlanta, Birmingham & Atlantic.

In building the Atlanta, Birmingham & Atlantic Railroad from Brunswick, Ga., to Birmingham, Ala., with a branch line from Manchester, Ga., to Atlanta, a large number of streams had to be crossed with steel bridges, some of which required unusually high abutments. There were also a considerable number of culverts, tunnels and retaining walls. The total amount of masonry for the line was so large that a special study of the relative advantages of plain and reinforced concrete construction was made. In order to determine the costs of masonry and reinforced concrete abutments, detail designs were made for a 42-ft. abutment for both types of construction, and it was found that a saving of 24 per cent. could be made in this instance by the adoption of the reinforced concrete design. It was therefore decided to use reinforced concrete abutments throughout the work.



Reinforced Concrete Abutment, Rear View; Atlanta, Birmingham & Atlantic.

There will be 69 reinforced concrete abutments in all, varying in height from 25 ft. to 61 ft. 6 in. from base of rail to under side of footing course. Some of these abutments have not yet been finished. While, in general, their design follows what may be called standard practice for this type of structure, a brief description of the 61 ft. 6 in. abutments, probably the highest of this type that have ever been built, will be of interest. Four of these abutments have been built, two at the Cahaba river crossing and two at Crooked creek crossing No. 6.

The Cahaba river crossing is composed of two 75-ft. deck plate girder spans and one 175-ft. deck pin-connected span. The abutments are both 61 ft. 6 in. from base of rail to underside of footing, supported on piles, the wing walls being carried back at an angle of 30 deg. with the face wall. The width of the base is 36 ft. at the center line, and 10 ft. 2 in. at the ends, the wing walls being 21 ft. high at this point. The base has an overhang of 8 ft. 6 in. beyond the face of the wall. A special feature of the design is the relieving shelf shown on the section through the center in the drawing,

and also seen in the photograph. Its purpose is to avoid excessive concentration of stresses at the foot of the buttresses. The design of the abutment did not permit splicing the main reinforcing bars in the buttresses, and the supporting and holding of these long bars during construction—the longest being 61 ft. 6 in.—involved considerable scaffolding.

In addition to the abutment work a large number of box culverts and tunnels were built of reinforced concrete. Among these were three double-track tunnels under city street crossings. The work required a total of nearly 1,300 tons of corrugated steel bars for reinforcement, which were furnished by the Expanded Metal & Corrugated Bar Co., St. Louis, Mo. The steel work for the bridges, which were designed for Cooper's E-50 loading, was furnished by the American Bridge Co. The reinforced concrete designs were prepared by M. O. Bellingrodt, Designing Engineer of the Atlanta, Birmingham & Atlantic, under the direction of A. Bonnyman, Chief Engineer.

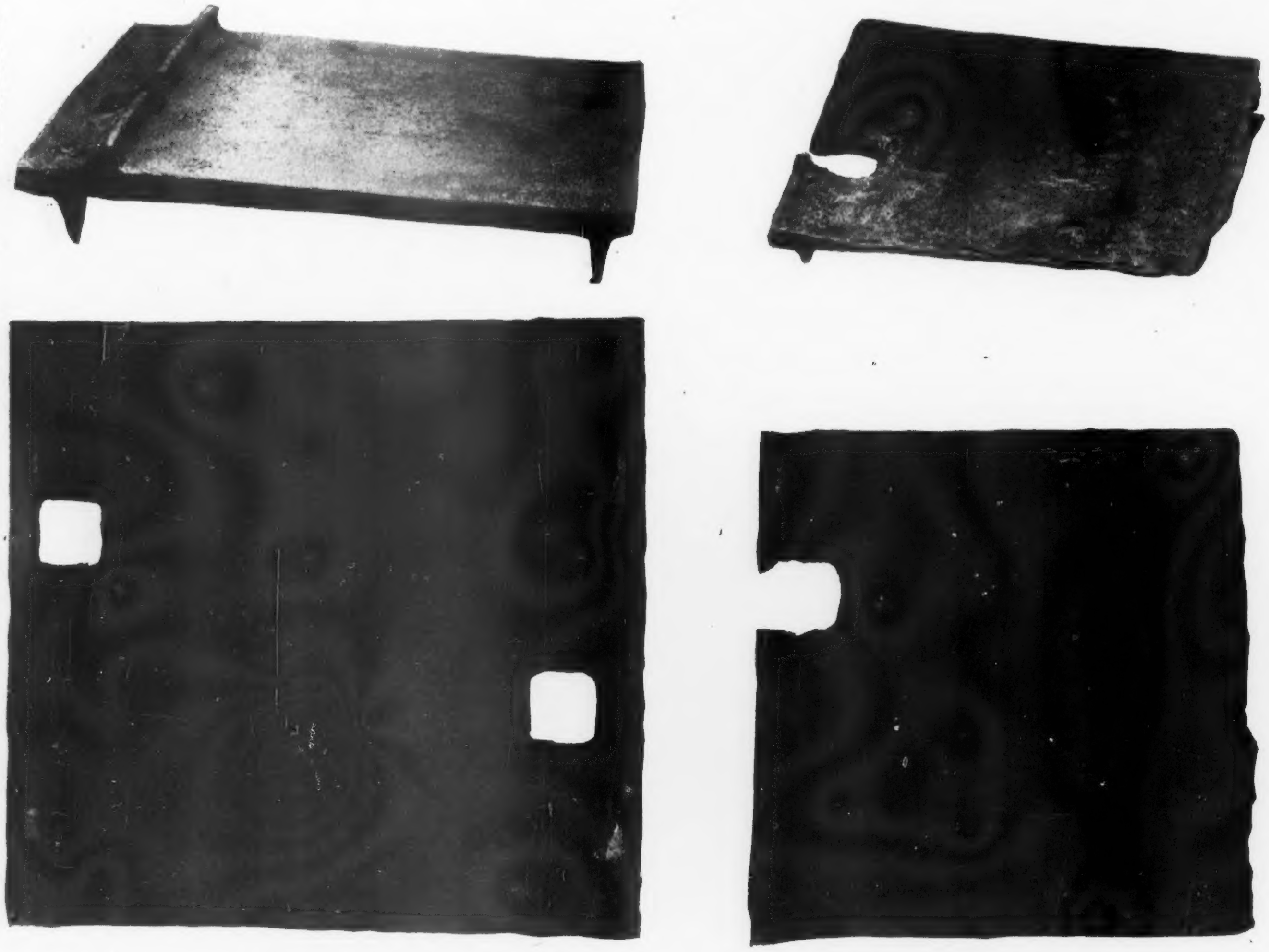
The Life of Steel Ties.

BY W. C. CUSHING,
Chief Engineer M. of W., Penn. Lines, Southwest System.

Mr. Haarmann has given track men some excellent information in his recent paper on the Metal Tie (*Railroad Gazette*, March 20, March 27, April 3), but the writer was disappointed in finding no statistical information on the *life* of the steel tie. Indeed, the only mention of its life is the estimate used toward the close of the paper, yet we have all been making such estimates for a long time and now need some facts to give us data to be used in our studies of the steel tie, because of the increased interest in seeking some other material than wood, which is getting more costly every year. The *Railroad Gazette* has also given us (May 1) a splendid summary of the experimental use of ties other than wood, principally concrete and steel, and it will be noticed that the problem is still far from solution. The one metal tie mentioned by Mr. Haarmann, which has had a remarkably long life, the Cosyns, put in the Belgian tracks in 1865, some of which are still in service, was of *wrought iron*. It is important that that fact be borne in mind whenever the Cosyns tie is mentioned, for it is now generally conceded that steel rusts more rapidly than wrought iron, and yet Mr. Haarmann never mentioned the materials. It is uncertain why steel does rust more rapidly, but Alberton S. Cushman's study on the corrosion of iron* and his electrolytic theory may throw some light on the subject. The writer quotes as follows from this extremely valuable report:

"A very widespread impression prevails that charcoal iron and puddled wrought iron are more resistent to corrosion than steel manufactured by the Bessemer and open-hearth processes. It is by no means certain that this is invariably the case, but it would follow from the electrolytic theory that in order to have the highest resistance to corrosion a metal should either be as free as possible from certain impurities, such as manganese, or should be so homogeneous as not to retain localized positive and negative nodes for a long time without change. Under the first condition the irons would seem to have the advantage, but under the second much would depend upon care exercised in manufacture, whatever process was used. * * * Carelessly made and poorly segregated metal will be easily attacked, no matter what it may be called or what method was used in its manufacture."

The railroad engineer has become very suspicious of steel when used for certain purposes in his work, especially when



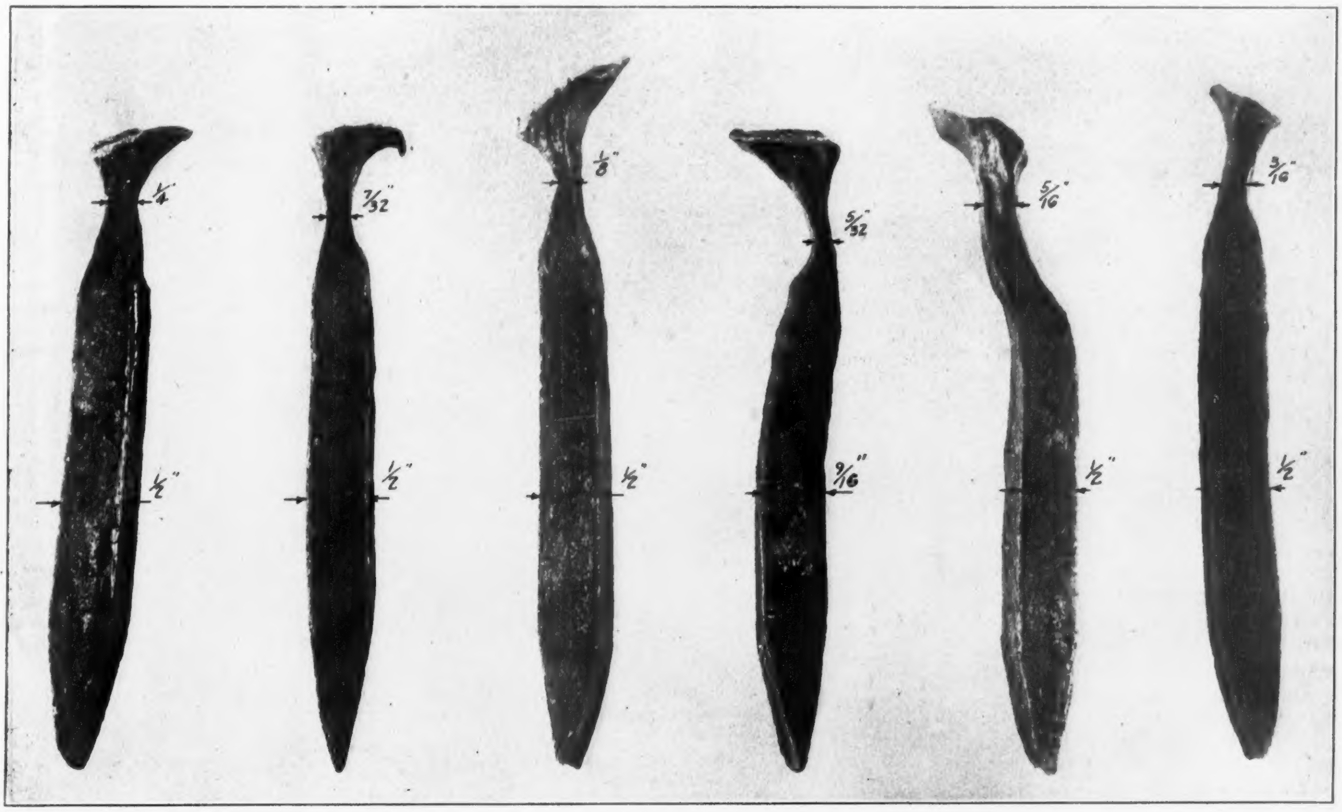
Figs. 1 and 2—Top and Bottom Views of New and Worn Tie Plates.

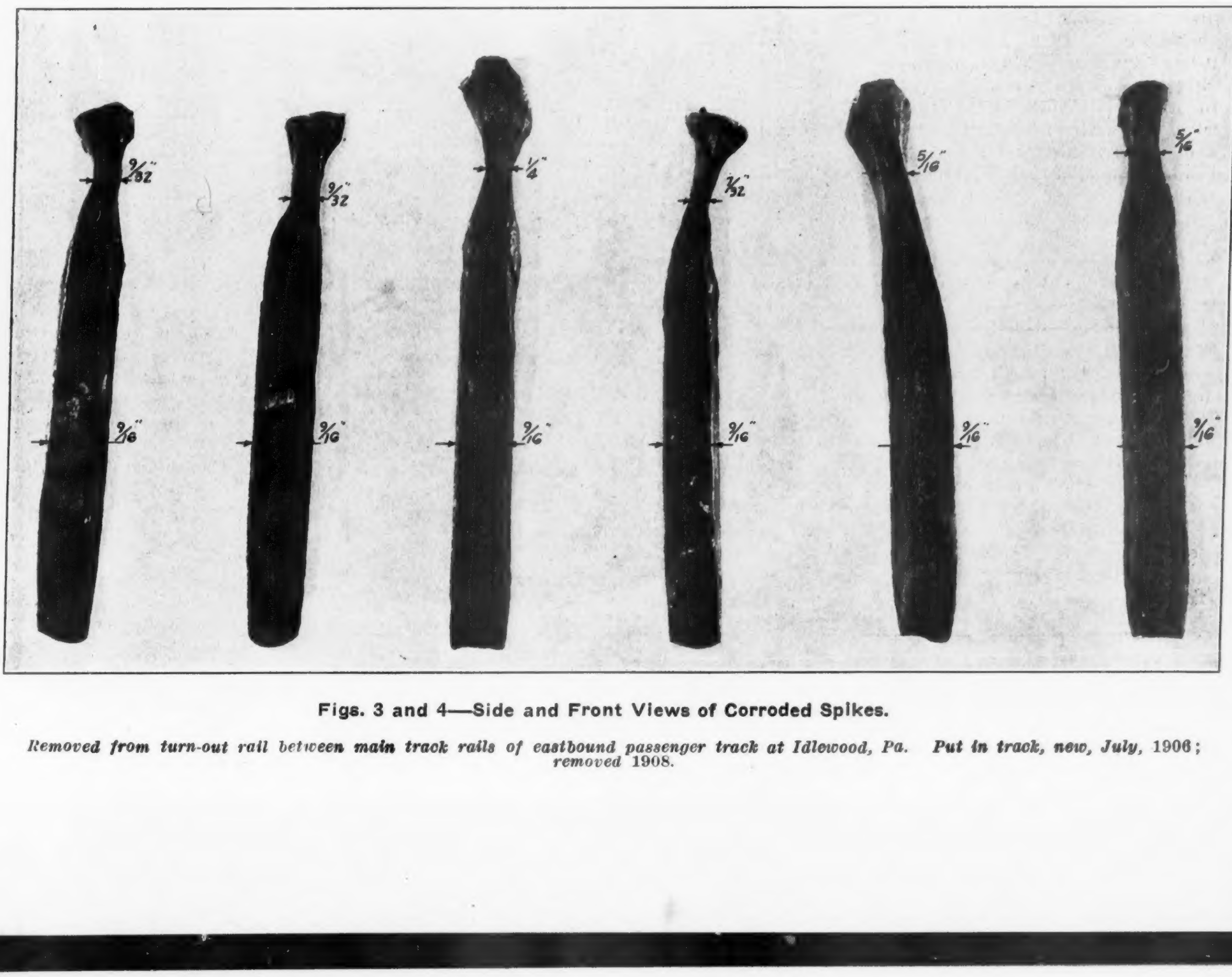
Weight: New, 5 lbs., 7 oz.; worn, 1 lb. 6¾ oz. Removed in 1907 after four years' service in P., C., C. & St. L. eastbound main track at Conesville, Ohio. Gravel ballast, A. S. C. E. 85-lb. rail, 1 deg. 54 min. curve, 5-in. superelevation.

*"The Corrosion of Iron," by Allerton S. Cushman, Assistant Director, Office of Public Roads, U. S. Department of Agriculture, Bulletin No. 30.

placed close to the ground, for his experience has shown him that rolled or pressed steel in such places, especially when in thin plates, say under ⅜ in. thick, has a very short life. When the pressed steel rail brace was first introduced, it was hailed as a great improvement over the old cast iron brace which frequently broke in service, but it was a case of "out of the frying pan into the fire," for the thin steel brace soon rusted away, and was useless in four or five years. The same fate overtook the steel slat cattle guard, and we are back to the use of wood.

We were not obliged to go back to the use of the cast iron rail brace when the pressed steel one failed, because, just at that time, the tie plate superseded the brace, except in the case of switch leads. These tie plates were of rolled steel for the most part, and we have found, from our continued experience, that they suffer just as much from the same disease—*rust*. In





Figs. 3 and 4—Side and Front Views of Corroded Spikes.

Removed from turn-out rail between main track rails of eastbound passenger track at Idlewood, Pa. Put in track, new, July, 1906; *removed* 1908.

some locations their life is unusually short, as will be observed from the accompanying photographs, Figs. 1 and 2. In order to show the wasting away at a glance a new plate has been photographed alongside of the worn one. While they have probably been somewhat affected by the brine drippings from refrigerator cars, which traffic is quite heavy on the railroad in question, yet the life, four years, is not greatly exceeded in other cases.

Another case of short life for steel is illustrated in the photographs of spikes, Figs. 3 and 4, which lasted only two years.

While it is true that steel in small pieces will disintegrate faster from oxidation than larger pieces, yet we cannot ignore the lessons of experience with these smaller articles, and must conclude that the larger articles, such as steel ties, will ultimately meet the same fate, but in a longer period of time. From the known deleterious action of brine from refrigerator cars (Fig. 5 illustrates its effect on a rail section in 15 years) it would seem to be folly on the part of railroad administrations to introduce the steel tie extensively into use until such time as the refrigerator trouble has been cured. The steel tie has therefore been seriously studied, because it is the belief of railroad engineers that the brine drippings from such cars will be ultimately cared for in such a way as to do no harm to the permanent way. Irrespective of the tie question, it is absolutely necessary that this reform be brought about on account of the serious damage to bridges and signal appliances, and, with that end in view, a committee of the American Railway Engineering and Maintenance of Way Association has taken the matter up with a committee of the Master Car Builders' Association.

In the March 27, 1908, issue of the *Railroad Gazette* Mr. Haarmann makes the following statement: "The Carnegie tie weighs 167 lbs., with a supporting area of only 705 sq. in. Structural improvements are under way, but it seems to me a mistake that, in introducing the steel tie in the United States so little use should have been made of the experience that has been gathered in Germany during the last 35 years."

In verbal discussions of the steel tie the writer has often made use of a similar expression, but it cannot be denied that it is somewhat difficult to find out where all the information on what has been done in Europe is to be found. The articles are generally widely scattered throughout the multitude of technical journals, home and foreign, and not always are the foreign articles translated into our own tongue. The writer feels sure that Mr. Haarmann has a fund of experimental information on the subject of this article, and hopes that he will give it to the readers of American journals.

In 1890 and 1894 Mr. Tratman, for the Bureau of Forestry,* collected the largest amount of information on metal track which had been gathered together up to that time, and with a view to learning from it which designs of metal ties had longest stood the test of experience, and, at the same time, ascertaining their period of life as determined from actual records, the writer made a summary of the main facts, which will now be stated as briefly as possible. He hoped in some cases to follow the matter up with correspondence, and indeed has gained some additional information in that way, as well as from additional articles in the technical papers. Such information is acknowledged from E. B. Thornhill, Engineer of the London and North Western Railway; A. Ross, Engineer of the Great Northern Railway; W. J. Cudworth, Engineer of the North Eastern Railway; Walter A. Cross, of the South Indian Railway, and from the *Railroad Gazette* and *Engineering News*.

*U. S. Department of Agriculture, Forestry Division, Bulletins Nos. 4 and 9.

In 1894 the metal track mileage was 20 per cent. of the total mileage of the world, exclusive of the United States and Canada.

The greatest mileage of metal track in any one country was in India, 13,645 miles, which was 50 per cent. of the total mileage of track in that country. Of this mileage 7,595 miles was of bowls and plates, mostly cast iron, and 6,050 miles of cross ties. In addition to this there were also many miles of metal track on the adjacent islands.

Europe was a close second in mileage of metal track, having 13,404 miles, but this was only 10 per cent. of the total. Almost 30 per cent. was on longitudinals, which were found to be unsuccessful, and were being discontinued. The attention of the recent advocates of longitudinals is called to this fact. Of course, it will be said that it was a fault of the design, and that the newer designs will overcome the difficulty. There were faults of longitudinal metal track brought out by those experiments which are as true to-day as they were then, one of which is poor drainage, and the problem is a great deal more difficult to solve for American railroads, with their heavy axle loads, than for those in Europe.

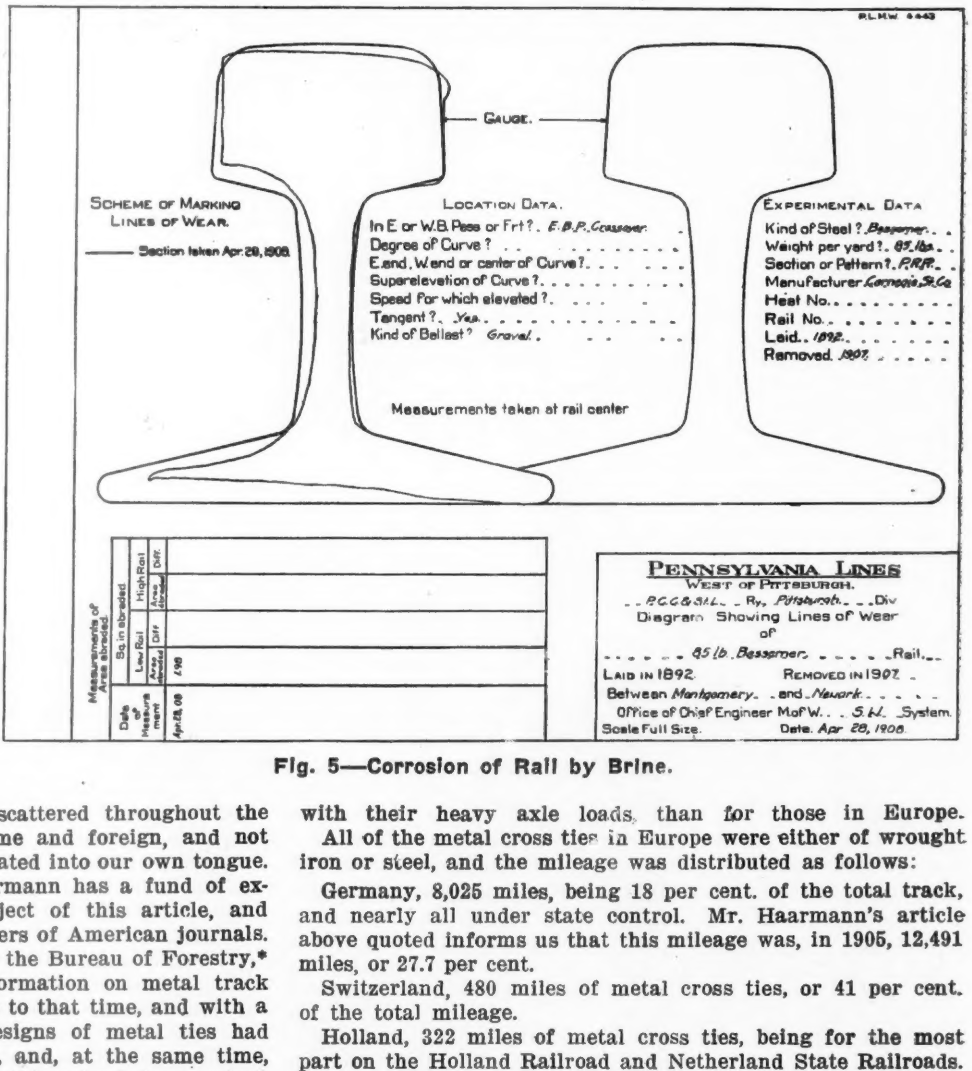


Fig. 5—Corrosion of Rail by Brine.

All of the metal cross ties in Europe were either of wrought iron or steel, and the mileage was distributed as follows:

Germany, 8,025 miles, being 18 per cent. of the total track, and nearly all under state control. Mr. Haarmann's article above quoted informs us that this mileage was, in 1905, 12,491 miles, or 27.7 per cent.

Switzerland, 480 miles of metal cross ties, or 41 per cent. of the total mileage.

Holland, 322 miles of metal cross ties, being for the most part on the Holland Railroad and Netherland State Railroads.

Belgium, 176 miles of metal cross ties, for the most part on the Belgium State Railroads.

France, 128 miles of metal cross ties, of which the State Railroads had 115 miles.

England, 73 miles of metal cross ties, of which 56¾ miles were on the London & North Western Railway.

In addition to the above, tropical countries have been good customers for the metal ties, quite largely on account of the wood-destroying insects, among which countries are those in South America and Africa.

South America had 3,555 miles of bowls and plates, mostly cast iron, and 861 miles of iron or steel cross ties, the total

of metal track being one-fifth of the railroad mileage in the country. While this country has an abundance of excellent wood, it has not been made generally available by transportation facilities.

Africa had 2,401 miles of metal track, or 42 per cent. of the whole, the greater part being of cast iron bowls and plates.

Having given the general summary of mileage above, it will be interesting and instructive to examine into the types of ties which have stood the test of time in those countries where the metal tie has been longest in use, and to look for data on the actual life.

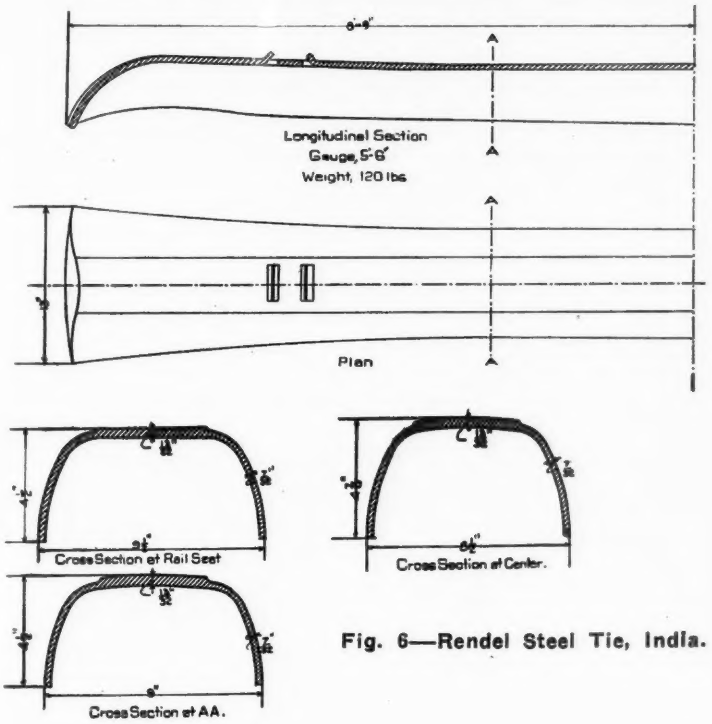


Fig. 6—Rendel Steel Tie, India.

INDIA.

Wooden ties do not last long in this country on account of quick destruction by insects, and there is also much saline soil, which is very adverse to the durability of the steel tie. As a result, the track of cast iron bowls and plates has been most extensively developed. Nevertheless, the breakage of these is found to increase with higher speeds.

The Indian State Railway had, in 1894, 2,113 miles of steel cross ties, and the North Western Railway 636, both of the same section, known as the Rendel. This type was by far the most popular of the steel ties, and is illustrated in Fig. 6.

As to its life, on the North Western Railway steel ties originally weighing 148 lbs. were found to weigh only 87 lbs. in four years, a loss of 41 per cent., which is very severe.

On the other hand, on the Oudh & Rohilkund, it was known that steel ties in another form lasted 16 years without injury.

The following remarks on corrosion of steel ties were made by the Consulting Engineer to the Government of India for State Railways:

"Close inspection in the case of cross ties that have been down from 6 to 8 years reveals considerable, if not serious, corrosion underneath and around the edges of the lugs and at the rail seat. It is now clearly recognized that a good road for heavy and fast traffic must be a heavy road, both in rails and cross ties. A cross tie weighing only 135 lbs. is too light for our standard gage for fast traffic, especially with rails that only weigh 75 lbs. per yard. For high speed traffic the cross ties would not be a bit too heavy if they weighed 250 lbs. each. A steel cross tie when rejected is practically valueless."

Remember that these words were written about 15 years ago, with reference to railroads on which the rolling stock was certainly not heavy.

In his estimate of the relative cost of metal and wood track Mr. Haarmann allows credit for scrap steel ties, while this writer just quoted above does not believe they will have any value when worn out. Mr. Haarmann estimates a loss in weight of only 20 per cent. in 20 years, and gives a credit of $10.90 per ton, against the original cost of $24.43 per ton.

GERMANY.

The Baden State Railroads have used steel ties since 1883. They were the Berg and Marche pattern (Fig. 7), weighing only 118 lbs., which was considered too light, inasmuch as speeds up to 56 miles per hour were attained.

The Heindl steel tie was used on the Bavarian State Railroads, and after 7 years it was said to show no wear. Heindl recommended a weight of 175 lbs. for main lines with heavy traffic.

These two ties, together with the Haarmann design, were the most successful types in use in Germany and Austria at that time, and we know from Mr. Haarmann's article that his design is still in successful use. Fig. 8 is the Haarmann tie, which was being furnished to the Oldenburg State Railroads* in 1907, and is much heavier (195 lbs.) than the earlier designs.

SWITZERLAND.

Nearly all the metal ties in use were on the St. Gotthard and on the Jura-Simplon.

On the former, in 1894, 124 miles, or 58 per cent., were metal cross ties, some of which had been in use since 1882. In 1898 the metal cross tie percentage had risen to 70 per cent., and the weight had been increased from 120 to 163 lbs. and the length from 7⅝ ft. to 8⅝ ft. This railroad has 43 per cent. of curved line, some of the curves being 6.3 deg. They had 100-ton engines, with an axle load of 15½ tons, which attained speeds of 53 miles an hour on the Valley Lines. The steel ties in the long tunnels rust out in 8 to 10 years, while outside they last as long as the rails. The design of 1898 is shown in Fig. 9.

In 1894 the Jura-Simplon Railway had 102 miles, or 33 per cent., of metal cross ties similar to the St. Gotthard ties, weighing 128 lbs. The heaviest engines were 67 tons, and reached speeds up to 44 miles per hour. The breakages were four or five ties per annum.

HOLLAND.

Prior to 1894 steel cross ties had been abandoned in Holland for financial reasons. The railroads were leased from the state by private corporations, and it was not considered any longer economical to continue the use of steel ties, because the railroads were liable to be taken back at any time by the state. The Holland Railroad abandoned their use in 1891. The axle loads of that railroad were 14 tons, and the speeds up to 50 miles an hour. On the Netherland State Railroad the maximum axle load was 15 tons and the speed up to 46 miles an hour.

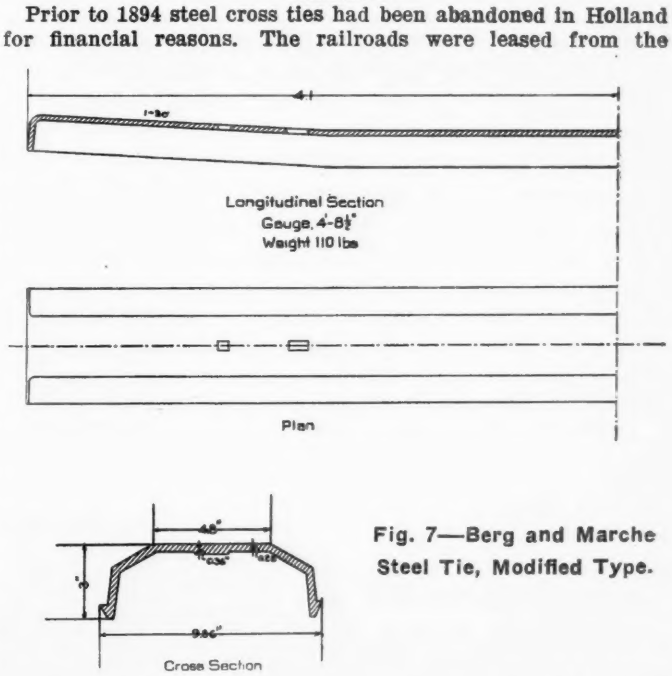


Fig. 7—Berg and Marche Steel Tie, Modified Type.

BELGIUM.

Belgium is the home of the Post type of steel tie, Fig. 10 illustrating the most developed design up to 1898, and the

*Railroad Gazette, Sept. 27, 1907, p. 353.

principal trials were made with different designs of that type.

The most systematic and thorough records of steel tie experiments were kept by Ch. Renson, Engineer of the Liege-Limburg Line of the Netherland State Railroad, and he made a complete report* comprising the period from 1881 to 1898, from which the following facts are taken:

The heaviest engine was 68 tons, with an axle load of 14 tons.

The first ties weighed 89 lbs., and after 16½ years 36½ per cent. had been removed on account of cracks, principally at the bolt holes. He thought the life of those ties would reach 22 years maximum, or an average of 18 years for all ties tested. Of another set of ties weighing 134 lbs. 30 per cent. were removed on account of cracks after 13½ years.

The measured loss in weight in cinder ballast was from 1.39 to 2.76 lbs. per tie per year. The measured loss in weight in sand ballast was 1.06 lbs. per tie per year.

Mr. Renson believed at that time in the success of the steel cross tie.

FRANCE.

The Eastern Railroad used some of the Post steel ties weighing 169½ lbs., but complained that they bent in the middle. It is noteworthy that the heaviest one mentioned by Mr. Renson was 134 lbs.

The State Railroads made use of the Vautherin type, of uniform section for the most part, and found that they cracked at the bolt holes. The trains on this railway run up to 50 miles an hour, and the locomotives weigh from 48 to 68 tons.

Mr. Bricka, after seven years' experience, does not agree with the Belgian State Railroads that metal ties are unsuitable for high speed traffic.

Mr. Cuënot, in his recent work on "Track Deformation," claims that even at the present time the steel tie of the State Railroads is weak in cross section and not stiff enough.

ENGLAND.

The most extensive steel cross tie experiment in England was made by the London & North Western Railway with the Webb ties, the first of which weighed 177½ lbs., including jaws, and were open at the end. They were later increased to 194 lbs., average cost 9 shillings each, but they only lasted 12

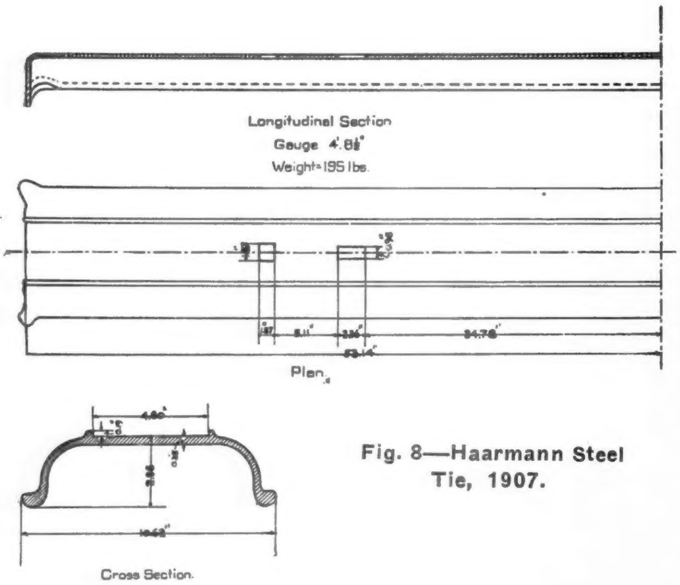


Fig. 8—Haarmann Steel Tie, 1907.

years in the main lines, having been laid between 1880 and 1890, as compared with 21 years for treated ties. There were originally 56¾ miles of them, and about 8 miles were still in side lines in January, 1908.

The Engineer says it is difficult to keep a road in good order where there is fast running, owing to small friction between the underside of the sleeper and the ballast. The steel ties suffer a good deal from *corrosion*, also loose rivets, breakages of jaw, wearing of sole plate between rail and sleeper and cracks in the tie under the rail.

The same type of tie was tried by the Pennsylvania Railroad, and it was found to be a failure, because the ties were too light and did not keep in line.

Although England once had 73 miles of metal track, the experiment has been practically abandoned, and that, too, notwithstanding the fact that a large number of metal ties for India, South America and various islands were manufactured by its mills.

AUSTRALIA.

It will be noted that the ties which have been illustrated are from 3 to 4½ in. deep. Australia is the only country which has used steel ties of the dish cover type as deep as

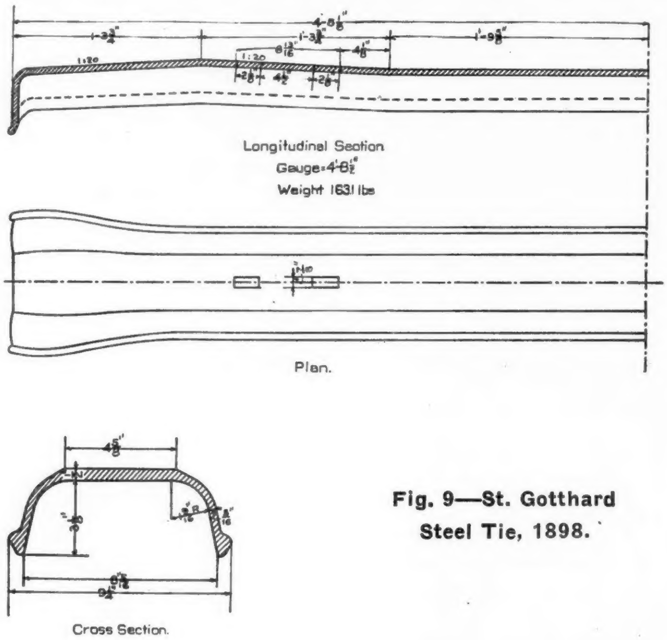


Fig. 9—St. Gotthard Steel Tie, 1898.

5 to 6 in., and the reason seems to be that they were laid in the natural ground, which was very level, without ballast, and were tamped from the end.

SUMATRA.

The following record of service on the Sumatra State Railroad by L. K. Lindhout is taken from the Bulletin of the International Railway Congress, December, 1899, page 1605:

The length of service was 9½ years from 1891, and 100,000 trains had passed over them.

They were Post ties of the fish-bellied type, weighing 86.58 lbs., with rectangular slots and rounded corners. The bottom ballast was of stone and the top of gravel and sand.

The engines weighed 34½ tons, with maximum axle load of 9.3 tons, and the maximum speed was 18.6 miles per hour.

Eleven ties were cleaned and examined, showing an average loss in weight of 0.22 lbs. per tie per year, or ¼ per cent. of the original weight when new, and there was some wear at the bolt holes on curves. The line is not far from the sea, and Mr. Lindhout estimated that they would last 23 years.

From the foregoing it will be observed that England used the heaviest steel ties, 194 lbs., and did not find them successful. The maximum life in main lines was 12 years, although they could subsequently be removed to side lines. This indicates that they were not heavy enough, and attention is again called to the statement of the Indian engineer that they should weigh at least 250 lbs. In light of these statements it is difficult to believe that the Carnegie tie, of 167 lbs., as stated by Mr. Haarmann, is sufficiently heavy, when our axle loads are over 30 tons, as compared with 15½ tons on the St. Gotthard Railway, and a weight of steel tie of 163 lbs. It is no wonder that Mr. Haarmann makes the statement quoted in full at the beginning of these notes, and the further statement as follows from page 447 of the *Railroad Gazette:*

"Merely glancing at this selection of widely used ties, it is evident that railroad men and rolling mill men were too long under the impression that they could get along with a minimum quantity of metal, a mistaken notion not entirely overcome at the present time."

*Bulletin of the International Railway Congress.

The writer believes with Mr. Haarmann that we have not taken up the steel tie problem from the point to which the Europeans have brought it, but are inclined to start anew in the dark with too light and too small ties, lighter and smaller than have been found to be successful in foreign countries, and that, too, with a service twice as severe as any foreign road has ever put upon them.

We want Mr. Haarmann and others to give us more light, in addition to what has just been published in his admirable paper, but we call his attention to the lack of dimensions on his drawings, especially those of the steel ties.

It is with satisfaction that the writer notes that this subject is to be reported upon by Mr. Byers at the International Railway Congress in Berne in 1910, but he would also be gratified to have the Bureau of Forestry bring its admirable reports of 1890 and 1894 up to date, for he feels sure that there must be some valuable statistical information, like that of Mr. Renson's, to be obtained at the present time.

There is no record of steel ties, indicating a greater life than 18 to 23 years, and it is quite evident that they must be much heavier than those heretofore used in Europe to give even that life under traffic conditions in this country.

Of course, when the ties are made heavier, they cost more, which is the reason for keeping the weight as low as possible. It seems evident, however, from what little we know of European practice that we must have a heavy tie, especially in view of the great difference in traffic conditions. According

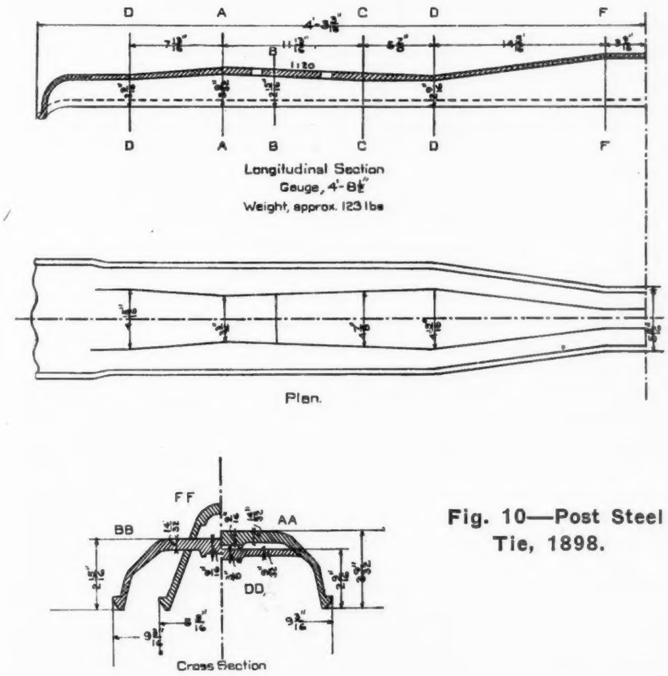


Fig. 10—Post Steel Tie, 1898.

to some estimates made by the writer in 1906,* when a white oak tie reaches a cost of 86 cents (it is now from 75 to 80 cents), it will be economical to use a steel tie costing $1.75, delivered, if it will last 20 years; or when a white oak tie reaches a cost of $1.03, it will be economical to use a steel tie costing $2.50, if it will last 30 years. These figures indicate the importance of having some definite data from European practice on their actual life. Even then the climatic conditions and methods of manufacture in this country may be so different that the deductions will only be approximate.

The steel tie, whether of rolled or cast steel, must, however, be reckoned with, as there seems to be only two courses to pursue in solving the tie question:

First.—If we are to continue the use of wood ties, it is absolutely necessary that we adopt a scientific and systematic plan of forest reproduction, and those trees only, with certain exceptions, should be considered which are indigenous to the soil, or at least find the conditions favorable to their growth, whether they be one kind of tree or another. Some of these trees will be durable, as the white oak, while others will require impregnation with a preservative fluid to make them last a reasonable time. Timber preservation in itself is not the cure-all, but will find its best field as an adjunct of practical forestry.

Second.—The only other practicable course to be followed, in accordance with our present knowledge, is to adopt the best possible design of metal tie, but at present it would seem that the wood tie will hold its own against the metal tie for a long while to come provided the plan of practical forestry be followed. The latter could be carried on indefinitely, at least till the country should become overcrowded, while the estimates of amount of available iron in this country do not extend beyond two generations. It is difficult to bring ourselves to believe this, but we are certain that iron ore is not capable of the same steady reproduction as the forests.

It is very likely that both materials will be used to solve the tie problem.

*American Ry. Eng. & M. of W. Association, Bulletin No. 75.

Locomotive Building in Switzerland.

The Schweizerische Locomotiv & Maschinen Fabrik, Winterthur, is working at present about 1,800 men. This is one of the best locomotive shops in Europe. Its engines are sent to all parts of the world. It is doubtful if there is higher finish to be found on any European locomotives than is given here, and the character of the workmanship is exacting. Here, as in Germany, it was observed that for the most part the plate-frame form of construction is being used, but the Swiss shops are about to undertake bar-frame construction, and the first set of bar frames has just been received by the Winterthur shops.

The Swiss locomotive works build gas engines as well as locomotives, but the locomotive branch of the business is the larger. The care bestowed on the locomotive work is noticeable, and great attention is paid to detail. Copper fireboxes and staybolts are the rule, as in other continental shops. The plate frames are first drilled out, but I did not observe any vertical millers for milling the interior edges of the blanks. The head of one of the departments remarked that he would like to put in a tool of the vertical-miller type for this work. The plate frames were being drilled out by Hartmann (Chemnitz) tools, and planed by tools supplied by the same firm. The new bar frames, which have just reached the Swiss shops, are of forged steel, and were received from Germany. I did not understand from my talk with the Swiss locomotive representatives that it is the intention to discard plate-frame construction, but rather to use bar frames for special types of locomotives. Among the engineers in charge of departments here is one man who saw service in the Baldwin Locomotive Works for several months. The engineers in charge of various departments at the Swiss Locomotive Works impressed me as being men of very high order.

A large number of American machine tools were in use in the Winterthur shops, and, as is usual in locomotive works on the Continent, there were also a number of the heavier types of English tools. It would seem as if the English machine-tool houses early contributed tools to the continental locomotive shops, and most of these are still in operation. It can be set down as a fairly correct statement that the English tools now being sold in Germany and Switzerland are for the most part from such firms as Herbert, of Coventry; Smith & Coventry, of Manchester; Darling & Sellers, of Keighley; Kendall & Gent and Richards.

The heavier machine tools at the Swiss Locomotive Works, outside of those furnished by English houses, are mostly of German and Swiss (Oerlikon) design, and the American representation is largely confined to lathes, millers, shapers and drill presses. The opinion was expressed at the Swiss works that too much money is being asked at present for the average make of American machine tools. The firm, it was stated, might recently have ordered a certain American boring mill, but the price asked was about twice as much as was demanded for a good German machine. It was correct to admit, it was said, that the American machine was a somewhat better tool, but the Swiss engineers did not think it better to the extent of nearly double the price of the German. On the other hand, it was remarked, such a tool as a Warner & Swasey hexagonal lathe was a splendid machine and was worth its high

price. These opinions are mentioned, as they indicate the trend of thought among men who buy and use American machine tools in Europe.

The gas-engine building branch of the Swiss Locomotive Works is an important one, and gas engines are turned out from these shops of as high as 1,000 h.p. The producers are of the suction-gas variety, using anthracite coal, but experiments are now under way with producers to use soft coal.

Krupp furnishes the most of the high-grade steel used in the locomotive construction, especially in the case of crank shafts and other parts demanding the best material. The Swiss locomotive shops make a specialty of rack engines for mountain grades, and this firm has probably had more experience in this line than any single shop on the Continent.

It is the writer's opinion that the Swiss locomotive shops should not be overlooked by American manufacturers. Good tools are required at this plant, and it is the policy of the firm to install only high-grade machinery. A tool possessing merit would be quickly recognized by the engineers in Winterthur.

The works are undertaking a limited amount of welfare work, and about 50 families are housed in neat dwellings in close proximity to the shops. The rental charges vary from 216 francs (franc = 19.3 cents) for three rooms to 300 francs for four rooms of medium size and 360 francs for four large rooms. The men of the families housed in these dwellings are nearly all members of the firm's fire brigade, and each home is connected with the fire-alarm signal.

The facilities for obtaining meals are similar to those in vogue at the Oerlikon shops, and here, as at the Oerlikon Works, the Sulzer Brothers, of Winterthur, have installed the steam-cooking tubs in which soup is prepared and potatoes and meat cooked.

There is a central building at the Swiss works, constructed at a cost of about $40,000, which is fitted up as eating-rooms and rooms for the instruction of apprentices. The basement of the building is divided into 53 bathrooms, similar to the arrangement at the Krupp Works at Essen, and at the Oerlikon Works in Zürich. The charge for a bath is about 2 cents American money. An old-age pension fund is maintained, amounting to 860,000 francs, and gives a pension varying from 600 to 800 francs to every person over 50 years old who has worked for them 20 years. This is said to be the only firm in Switzerland that pays pensions on so large a scale.—*Consular Report.*

Piston vs. Slide Valves.*

My experience is that the piston valve is more economical than the slide valve. As to cost of construction, any mechanic will agree with me that the quantity of material in the piston valve is less than that in the slide valve, and also that it requires less work in making. It requires less time to apply the piston valve to an engine than the slide valve. Its cost to maintain is less than that of the slide valve because it is easier to apply new rings to the piston valve than to take down the steam chest cover and apply new strips or springs, as the case may be, to the slide valve. The ring in the piston valve is no more liable to break than the strip or spring in the slide valve. It is true that in case of the ring's breaking the engine blows as bad, if not worse, crippling the engine as quick or quicker, than the breaking of the strip or spring in the slide valve, depending on the size of the piece broken from the ring. However, valves properly put up and of good material, should last from the time an engine is shopped until it is again ready for shopping. We find this no uncommon thing. We have had to repair the slide valve on the cross compound as many as three times between the shoppings of the engine, while occasionally we have had to renew the piston valve on the simple engine even more than this, but I attribute the cause of the latter to the way the valve stem is put up at the factory. They are fastened to a crosshead valve stem going through the crosshead piston with a nut on each side of the crosshead and a little dowel pin to hold the valve in position. I think this a very poor arrangement for holding the valve in its proper place, as it is easy for the dowel pin to be put a little out of line, which throws the valve ring joint off the broad bridge, allowing the ends of the ring to strike the ports. I consider this the cause of the ring's breaking as frequently as they do. I think the valve stem should be fastened with a key, which would eliminate this trouble.

The piston valve operates on one-third less oil than the slide valve, due, I believe, to the fact that the piston valve is more perfectly balanced than the slide valve, hence less friction. Piston valve engines are smarter than slide valve engines. This is because the valves are so perfectly balanced and have a larger exhaust cavity, making the engine freer in relieving itself at the proper time.

*From a paper presented at the International Railway General Foreman's Convention, at Chicago, by B. A. Beland, Roundhouse Foreman of Frisco System.

Column Formulas and Lattice Bracing.

In one of the appendices to the report of the commission on the failure of the Quebec bridge, there is brought out with startling vividness the paucity of our information regarding the true basis of calculating stresses on the latticing of built-up compression members, as well as the action of large columns under compression loading.

In designing the cross section, the arrangement and dimensions of the web system are first considered, and column formulas based on experiment are used for the purpose, and these give the average unit stresses under which columns fail, in terms of their length and radius of gyration. And then a factor of safety suitable to the design is used. In short, the web system is designed from column formulas or the plotted results of experiments.

The design of the lattice system is quite a different matter. As a rule it depends on the judgment of the engineer guided solely by experience. He finds little or nothing in scientific text books or periodicals to assist his judgment. Some lattice formulas are in existence, but they are not generally known and their utility is more or less doubtful owing to the uncertainty of the data and assumptions on which they are founded. The unsatisfactory nature of the column formulas upon which the web system is designed is a matter of common knowledge among engineers, but the column formulas may be considered to represent exact science in comparison with the lattice formulas.

The lattice system performs two distinct functions. In the case in which each web of the web system carries its share of the load, that is to say when there is no transfer of load in any part of the column from one web to another, the lattice system simply acts as a side support to the web system and by means of it a long web is divided up into a number of short columns. The stresses thrown into the latticing by this action cannot be computed. In this case the load on the column is parallel to the axis, but not necessarily coincident with it, and the curvature is assumed to be negligible. When, however, the load is inclined to the axis of the column, the lattice system has a different function. The angle of inclination may vary from point to point along the column owing to the curvature of the column. This curvature may be due to original bends or to the action of the load or to both combined. If the curvature is sufficiently small the variation of inclination due to it will be negligible. There remains, however, the original inclination or obliquity which is due to the method of application of the loads at the ends of the column. If the eccentricity of application is the same at each end and in the same plane with the axis of the column, there will be no obliquity other than that arising from the curvature of the webs which may be negligible. If, however, the eccentricities at the opposite ends are different or in different directions the obliquity may be of considerable amount. If the curvature of the column be negligible the obliquity arising from the eccentricity will be the same at every point. This obliquity causes a transfer of load throughout the whole length of the column from one web to another. This transfer of load is accompanied by longitudinal shearing stresses in the lattice system. The obliquity also causes transverse shearing stresses at every cross section of the column.

If the lattice system is considered to be sufficiently stiff the longitudinal shearing forces can be derived from the transverse shearing forces by the ordinary processes of statics

as applied to elastic solids, and from them the lattice stresses and the lattice cross-sections may be computed.

In calculating the stresses due to eccentricity of loading, an assumption of this eccentricity must be made and this value depends to a great extent upon the excellence of the design and of the workmanship as well as on the care and precision exercised in erection. It is impossible to estimate this value with accuracy and the limits for it can only be learned from experience and study. With bad work and more especially bad fitting and splices, the value may be much greater than it need be under other conditions of construction. In design, however, good workmanship and strong splices should be assumed. Theoretically the cross sections of the latticing should be designed so that with the assumed eccentricity the latticing and the web systems will get their ultimate safe stresses simultaneously. This connection will be satisfied if the unit stress in the latticing has the same factor of safety as the maximum compressive stress in the web system corresponding to the eccentricity.

If then the load is central and without obliquity and the load approaches, or is equal to the elastic limit of the material, no part of it can be transferred from one web to another without inducing stresses in the second web in excess of the elastic limit.

The function of the latticing in such a case is simply to stiffen the webs, and the accompanying lattice stresses cannot be computed. The condition necessary for a theoretical computation of the stresses in the latticing is that the difference between the load and the unit stress must be reasonably large. Lattice formulas, of course, fix the value of the unit stress after a fashion, but only tests and experience can determine whether or not these give economical and safe results. Direct tests are difficult to apply and unless great care is exercised incorrect inferences may be drawn from them. A lattice column placed in a testing machine may fail in the web system, but this is no indication that the lattice system is strong enough for service in a similar column when in use as a bridge member. It may be that the obliquity of the load was too small to develop the lattice strength, and considerably less than the obliquity that would be found to exist on the bridge. With a greater obliquity the column might fail through the lattice system under a much smaller load. In other words, the failure of the webs is an indication that the full strength of the column has been nearly developed. The failure of the latticing may not be such an indication. The full strength of the column can be developed only by axial loading, and under such loading comparatively weak latticing may serve to develop this strength.

The full strength of the latticing can be developed only by oblique loading. The column strength in this case must be less than under axial loading, as otherwise failure would occur first in the web system.

The failure of lower chord A 9-L Quebec Bridge is an example of an insufficient lattice system. The webs bent and the lattices failed under a load only three-fourths of the specified maximum working load.

Mr. Szlapka, in his evidence, states that after a most painstaking search the only information he could find on the subject of lattice computations was that given in Johnson's "Modern Framed Structures."

The experience of the Commission is practically the same as that of Mr. Szlapka for, except the rule in "Modern Framed Structures," all the information that they were able to find has appeared in the periodical press since the collapse of the Quebec Bridge.

Mr. Bindon Stoney, one of the earlier authorities on bridge construction, has given a method of computing statically the stresses in lattice existing in a bent column.

The article in "Modern Framed Structures" is as follows:

"There are no rules other than empirical ones in use by which the size and spacing of lattice bars for compression members are determined. . . . It has been suggested that, as our compression formulas all assume a certain extreme fiber stress due to the flexure of the strut, from this known extreme fiber stress we find as equivalent uniform load acting in the plane of the latticing which will produce this fiber stress and from this load find the stress in the lattice bars."

Mr. Szlapka used the rule in "Modern Framed Structures," but modified it by using a central instead of a distributed load. This modification had the effect of making the area of the lattice bar one-half of that given by the method suggested in "Modern Framed Structures."

Mr. Szlapka finally adopted a larger cross section than his method gave, and one which, in his judgment, was sufficient.

If he had tested the method fully he would have found it capable of giving areas ranging up to ten times the area computed by him, a result which would have shown the unreliability of this method. He might, of course, have come to the conclusion that a rule capable of giving such different results was valueless.

There are five formulas that have now been put forth for these calculations which give widely varying results for the section of the lattice in tension. These results, as given in the report, are as follows for the several formulas:

Prandtl	3.50 sq. in. 5.88 "
Engesser	7.04 "
Prichard	3.78 "
Modern frame structures	3.38 " 1.50 " 0.75 "
Keelhoff	2.64 "

These are certainly widely apart in their variations and sufficiently confusing, the values being dependent upon the value of the ratio of the difference between the unit stress of the most compressed edge less the safe load per square inch and the unit stress in tension. Mr. Szlapka in his design made the section 1.15 sq. in., whereas the rule is capable of giving values ranging from .75 sq. in. to 3.36 sq. in.

The range of values is even more indefinite than the numerical values indicate, depending as it does on the varying opinions regarding the values to be assigned to the constants of the column formulas.

It is evident that the number of rivets necessary to develop the values of the larger sections given above would make the use of lattice bars impossible. Cover plates and horizontal diaphragms would be required.

In summing up these conditions and applying them to the fallen bridge the commission says that it is impossible to state why the maximum deflection took place at the point it did. There may have been an original deflection of a small amount there, a defect in workmanship or a local injury from the fall that the member had had. And the explanation of the failure of the chord under three-quarters of its maximum working load contains assumptions which render it only tentative. It indicates the dangerous effects of even small obliquities and deflections on the safety of a chord with weak latticing. It is quite probable that the obliquity was in great measure due to movements at the field joint in panel 9 L, which was rivetted up, and at the field joint in panel 10 L which was being rivetted up at the time of the collapse. In fact, all the troubles in the lower chords of both anchor and cantilever arms which developed after Aug. 6, 1907, seem to be partly attributable to movement at the field joints. These movements were noticed principally in the inner webs, which have much less horizontal stiffness than the outer webs. These webs were intended to carry the same unit loads as the outer webs, and yet at the field joints they were connected to the cover plates with only half as many rivets, the small web angles used not permitting more. The outer webs with heavy angles and fairly effective latticing seem to have stood up under the stresses—the small angles and inefficient splicing and latticing of the inner webs allowed them to yield, thus disturbing the intended action at the field joints and panel points and giving opportunities for unforeseen eccentricities of loading. Heavier angles on the center webs under the cover plates, heavier splicing and heavier top and bottom cover plates would have added much to the efficiency of the joints.

An important function of cover plates is that they maintain the webs or ribs at their proper distances apart, but in erection, the bottom cover plate was taken off during the rivetting up of the joint, and was replaced by small angle bars which were entirely too slight to perform the function of the cover plate. This is shown by the fact that a much greater movement was noticed at the bottom of the center webs than at the top.

The foregoing discussion shows that even at the present time theories of lattice design are seriously in conflict and

the strength of any lattice system will vary materially according to the formula adopted. Mr. Szlapka used, with his own modifications, the only system of lattice computation generally known to American engineers. This method involved the choice of a column formula from which to determine certain quantities necessary in the lattice computations. Mr. Szlapka selected the column formula adopted by his own company, and used the constants for it that, in his judgment, were most in keeping with the conditions of the case and in best accord with the spirit of the specification. He made what he considered a liberal increase in his adopted sections over what his computations called for. The result has shown that his judgment was faulty, but we are not prepared at this date to define the maximum safe sections for the latticing for these chords. The profession has learned much from the mistake, but it is not even yet in a position to determine the percentage of the error. The lattice of the model chord No. 2 that was afterwards tested by the commission were made only at 50 per cent. heavier than those used on the Quebec chords, and yet they did not fail until the webs buckled. The weakness of the theory upon which they were designed would have been indicated if a study had been made of the results obtained with different assumptions:

The application in practice of the theoretical formula given in our discussion depends upon our ability to select values of unit stress and safe load suitable to the detail of construction in the special column under consideration. The values safe loading are determined in practice by the use of column formulas, but no one contends that the range of the tests upon which these formulas are based is sufficiently extensive to cover all the conditions that affect column strength; the formulas are simply accepted as the best guide that we now have. The maximum value of the unit stress will be fixed by the characteristics of the metal to be used. It is evident that by experience these values may be gradually determined which will make it possible to design latticing that will be unquestionably safe and not unnecessarily heavy. We may here point out that great compression members, such as the Quebec bridge chords, call for just as much individual study in design as an ordinary small bridge, and that any specification for such members should give reasonable latitude for the exercise of judgment by the designing engineer.

When the whole discussion is summed up, it resolves itself into a startling demonstration of how little is known regarding column strengths and lattice bracing and what a wide and valuable field there is for investigation along these lines.

Locomotive Repairs.*

The mileage of engines in different class of service and in different localities should be considered in the total mileage expected. The cost of shop and running repairs should be handled as economically as possible. Three different classes of repairs are to be considered in shopping an engine: light repairs, such as will cost for labor and material from $50 to $400; heavy repairs from $400 to $1,000, and general repairs from $1,000 up. Gangs should be organized with foreman in charge of each to handle the different classes of work. There should be also a floating or extra gang, which could be used to assist in forcing along work behind in the schedule, or to supply men to fill out in other gangs. There is always sufficient work in shops to keep this extra gang busy in other ways. The work and the number of men in the different gangs should be so planned that each gang can do its work and keep up with the schedule. The work at the machines should likewise be so planned. If all the details of organization are not closely watched the cost of output will invariably increase. In case of running repairs the reports of engineers and inspectors should be closely watched, and all class of repairs be made promptly, as neglect of this class of work always leads to more serious defects and consequently more expense. Keeping up running repairs in good shape will increase the life of an engine and lengthen the time between shoppings.

"Does it pay to overhaul an engine that will give but 90 days flue or firebox service? How could this be handled?" It would not pay to overhaul an engine that will give but 90 days service of flue or fire-box. I think the conditions at point of shopping and also the size of power to be overhauled should govern this. If there were local or branch runs where this power could be used for 90 days or the power could be used in yard service for that period, this should be done; if such conditions do not exist, then I believe it would be wise to repair flues or firebox at the time of machinery overhauling.

"Who should determine when to shop an engine? And who should furnish work report?" The mileage made by engines should, to a great extent, govern the shopping, but in cases where engines have not made their allotted mileage and are unfit for service, continually having failures on the road, then the general foreman and road foreman of equipment should take these cases up with their master mechanic, stating the facts. The work reports should be furnished by the engineer who runs the engine, if regularly assigned to the engine, and by the engine inspector, roundhouse foreman and road foreman of equipment, if the engine is in pool service. In the latter case the work report from the engineer would not be necessary. When an engine arrives at the shop and is stripped, a competent inspector should go over each part, thoroughly noting wear of parts, and add his report to that of the others for the information of the general shop foreman.

*From a paper read at the International Railway General Foreman's Convention at Chicago, by T. E. Bronson, of the Chicago, Rock Island & Pacific Railway.

Northern Pacific Tie Treating Plant.

The Northern Pacific Railroad recently put in operation, at Paradise, Mont., its second tie treating plant, the first being at Brainard, Minn.

With a working force of two shifts of 75 men each, the plant has a capacity of 10,000 ties in 24 hours, at a cost stated as being 30 cents per tie. The plant and yards occupy a space 400 ft. by 5,000 ft. The equipment includes a cylinder house or retort building, of corrugated iron on a steel frame, 40 ft. by 157 ft., which contains two 30,000-gallon steel creosoting cylinders; one 38,000-gallon receiving tank; two 30,000-gallon elevated charging tanks and a 160-gallon storage tank, which receives the cresote oil from the tank cars. The steel cars for carrying the ties into the cylinders, as well as the machinery of the cylinder house, are operated by power from a 75 h.p. generator. The yards are wired for lights so that both shifts may be used when necessary.

After remaining in the seasoning yards from three months to one year, according to the variety of the timber, the ties are loaded on the steel cylinder-cars, each of which holds 45 ties. A train of 16 of these loaded cars then goes into the 7-ft. by 133 ft. impregnating cylinder. After securing the doors, creosote oil at 180 deg. temperature is pumped into the cylinders, continuing until the pressure is from 75 to 180 lbs., according to the timber. This is maintained for half an hour to two hours, in which time each tie receives about four gallons of oil. The drains are then opened and the free oil allowed to flow out; all surplus oil is withdrawn by a vacuum pump, which maintains a 20 to 25-in. vacuum for an hour and a half. This not only saves the surplus oil, but also leaves the treated tie sufficiently dry for immediate handling.

This process is said to insure a good penetration with a comparatively small net absorption of oil. Ties of birch, ash and elm are treated together, while those of pine and red oak each separately.

Each cylinder is supplied with a recording instrument, which includes a pressure and vacuum gage and a pyrometer, and indicates at all times the amount of oil in the cylinders, and also the movement of the oil to and from the charging tanks. The gage divisions are made sufficiently small to permit readings within three or four gallons. The piping system is so arranged that should one machine or tank become crippled the other may be operated independently, which overcomes a shutdown of the plant. Each charging tank is connected with each creosoting cylinder, as are the pressure pumps, and a double service line is provided from the storage tanks to the pump room.

The plant was built by R. A. Tanner, construction engineer, under the supervision of Andrew Gilson, superintendent of timber preservation and tie treatment.

Picked Up on the Road.

BY GULF.

Some of the roads between New York and Chicago run certain fast trains, according to their guessing sheets, upon which an extra fare is charged, and the road in return therefor guarantees to deliver the passenger at destination or forfeit a rebate at the rate of a dollar an hour for the time that the train may be late. This sounds like a fair and square bargain when the ticket is bought, and the passenger, if he is a novice, feels reasonably sure that somebody will attend to business and get that train through on time. But, the company says an hour is an hour and that it takes 60 minutes to make it, and so unless the train is an hour late, why, the guarantee doesn't hold. I believe, however, that they will count 57 minutes as an hour. The general passenger agent spends thousands of dollars a year advertising these fast trains, and utterly forgets the value of the patron's talk as an advertising medium for good or bad. Theatre men know that to send out an audience that will talk about the play is worth more than all the newspaper advertising in the world. So, too, a railroad. If it would live up to the strict spirit of its guarantee and pay for every minute its trains are late, it would send out a crowd that would brag about its squareness and that would be more pleased over a 25-cent rebate than a child over a new toy. It would be advertising that would advertise. As it is, they feel imposed upon, and then go away disgruntled and join the great throng that's got it in for the railroad.

The New York Central is doing a little bit of advertising on trains entering New York, that, while it may not be a great income producer, is a convenience to the passenger, whether a native or a stranger. It is a slip containing a list of hotels with their character and prices; a complete list of all of the theatrical attractions, and another of the main points of interest in and about the city. It is just the sort of information that everybody wants, and it ought to be appreciated. Incidentally, of course, there are some remarks regarding the greatness of the road issuing the sheet and the swiftness of its trains. But the value consists in that information which people want. It is a scheme that is worth imitating at even smaller places, and if the railroads do not do it, private enterprise might find it a paying proposition to take the cue and work it out.

The commission appointed to report on the failure of the Quebec bridge has concluded its work, and in its report it has stated that the disaster was due to the adoption of too high unit stresses in the members per square inch of area, and that to do this was an error of judgment, especially in view of the fact that there was no precedent for such action, and now it is urged that "all doubts as regards these important features . . . should be eliminated by extensive tests, as arguments advanced by theoretical investigations are based on more or less vague assumptions." This is good philosophy to follow before purchasing another horse, especially after one has been stolen. But how about the other barns? Aren't we just working a little on the "high safety" limit in connection with such details as—well, say car wheels? We have had a few startling indications along these lines during the past year, and this working up to 75 per cent. of elastic limit is checking off pretty well with the use of the same factor at Quebec. Not in producing a series of the greatest engineering disasters that the world has ever known, but in a series of accidents that will some day be difficult to explain to an investigating committee that is backed by a howling mob of unreasoning public opinion. If car wheel stresses are anything like what they are said to be, it looks as though the time had come to sit up and think, and think hard.

I often think that the man who first designed the high car window that will only lift until the lower sash rail comes directly in the line of vision did more for the appearance of the car than he did for the comfort of the occupants. Most people like to look out of the window when traveling, and this bar, when the window is open, is an annoyance—not to call it a nuisance. But, then, by slouching down in the seat and looking under, a man can see out. It has, however, remained for the Pullman Company to cap this by an ingenious arrangement of screens by which the whole lower portion of the window up to the eye line is effectually blanketed. I was in a car like this the other day running south with a resort contingent, and it was pitiable to see that whole carload of passengers craning their necks to look out. They kept it up for about an hour and then settled back into their seats, wearied with the exertion, and for the balance of the journey they might as well have been in a rear flat of a city apartment house for all that they could see of the passing show. All of which merely goes to prove the soundness of the assertion made in these columns time and again—that it is well for these designers of railroad devices to try them out on themselves once in a while before condemning the traveling public to put up with them.

It is always a pleasure, especially for a scold, to be able to point his preaching with a fact. Hardly had I written my plea to managers and superintendents to talk to their men than I had occasion to require some detailed railroad information. So I applied at the offices of two superintendents of motive power where I hoped to obtain it. They were using the device that I wanted to know about, but beyond the fact that they knew that they had it applied to so many cars, could say nothing. They had no idea of its cost of maintenance or operation, of its efficiency or durability—nothing but that it was there, not even the cost of installation. To secure any information looked rather hopeless, and I asked who had charge of the device, and was at once given a letter to the men who were responsible for its operation. Did they know anything? Well, rather. They could tell more of cost, efficiency, troubles, advantages, disadvantages, comparative value with other devices, and so through the whole gamut of the knowledge derived from practical experience than their superiors apparently ever dreamed of, and I came away knowing more of the ins and outs of the working of the apparatus on those two roads than any officer on the staff, and it didn't take much time, either, for the men knew what they were talking about, stuck to their subject, and had the relief of letting themselves out and expressing themselves to an interested party. Then I harked back to what I had just written, and thought that if I, a stranger, could tap that mine of information with so little effort, what could the manager or superintendent or superintendent of motive power have done or do if they only thought it worth while to call the men in and talk a little, only a very little, once in a while.

It seems to be a pretty well established fact that superheated steam is a profitable thing in a locomotive, and that the statement applies as well to compound as to simple engines. In the case of the former, however, there is still some doubt as to just how the superheating should be done. That is to say, should the whole energy be devoted to the steam before it is admitted to the high-pressure cylinder, or should there be a reheating and added superheating between the two cylinders? The point is one that will probably require some time and more expense to settle, and is under investigation at the present time in Europe. When our friends over there have demonstrated to their own satisfaction which is the better plan, we may hope to see some attention paid to the subject. Meanwhile, to quote an oft-repeated phrase used by progressive American railroad men, "We will let the other fellow do the experimenting."

An interesting point was brought up at the last M. C. B. convention in the discussion on the responsibility of certain railroad companies for cars destroyed in the Kansas City floods. The owners claimed pay for the cars lost, and the railroad on whose rails they were at the time claimed immunity in that the loss was due to an act of Providence, over which it had no control. Apropos of this, the case of a farmer may be cited. This man built a house upon these very flats, and when asked if he were not afraid that it would some day be swept away by flood, replied: "Yes, it probably will be, but such floods are of uncommon occurrence, and the convenience of living down on my farm warrants the taking of the chances, as the saving in time and labor will more than pay for the house."

The floods came and the house was swept away. It is quite pertinent to ask whether it is not quite possible or probable

that the same sentiment animated the engineers who laid out the railroads over these same flats. The saving and convenience warranted the risk. If, however, they were less foresighted than the farmer, and built in absolute blindness and ignorance of the flood possibility, it is a sorry showing that they make for themselves. But, granted that the roads were so neglectful of the ordinary precautions of the engineer and so ignorant of the rainfall and drainage area of the streams that they can shelter themselves behind Providence, what can be said regarding the future? No immunity can ever be claimed again because of ignorance of possibilities, and certainly, now, the managements are putting themselves in the identical position of the farmer who considered that convenience offset risk. Surely man will hereafter have to share with Providence the responsibility for losses by flood on the Kansas City flats.

The Gisholt Big Bore Lathe.

The economical production of various parts usually turned out in railroad repair shops has been a troublesome problem because of the comparatively few pieces that are run through at a time. Repair shop methods are necessarily slow because it does not pay to rig up specially for the various jobs, and therefore the wider the range of a machine tool, and the greater the ease with which it may be adapted to various classes of work, the more valuable it is in such shops.

A recent development along these lines has been that of a big bore lathe by the Gisholt Machine Co., Madison, Wis. It is a combination of a bar and chucking lathe having so wide a range of work that it can be kept busy at all times in a repair shop. It is adapted to such work as finishing liners, brasses, pistons, piston centers, cylinder heads, piston followers, bull rings, eccentrics and straps, cross heads, pipe flanges, steam chest covers, and work off the bar, such as cross head pins, valve motion pins, brake hanger pins, etc. In comparison with other methods of doing these two general classes of work, it is claimed that, even with small lots of but six or eight pieces, a saving of from 50 to 80 per cent. or more can be effected.

Since the various pins above mentioned may be made from bar stock, the expense of forgings is eliminated. In addition, because of the way in which the work is chucked, there is no time lost in centering, as with the older methods.

In some shops such parts as knuckle and cross head pins are finished complete except the tapered surfaces; these are left large and are finished to size as required.

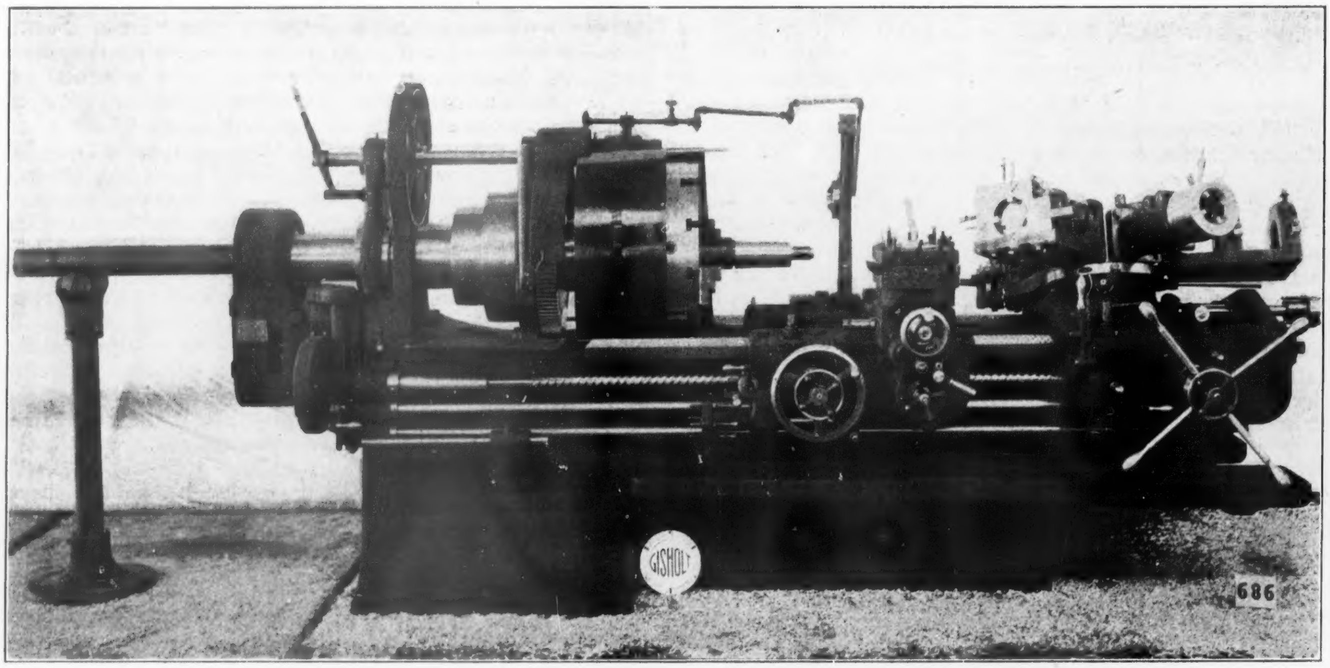
A general idea of the method of finishing work from the bar may be gained from the following description of the method of finishing a cross head pin on this lathe.

The piece of bar stock, shown at A, is held in the three-jawed scroll chuck by hard chuck jaws at B and also by three chuck blocks at C. The first operation consists of removing most of the stock and bringing the pin approximately to size. This roughing operation is completed by the cutters shown in the box tool attached to face 2 of the main turret, the cutters E-1, F-1, G-1, H-1, I-1, J-1 and K-1 removing the stock on the surfaces indicated by the corresponding letters on the piece itself. Just before starting this roughing head, the tool post tool N is used for truing up the end of the bar.

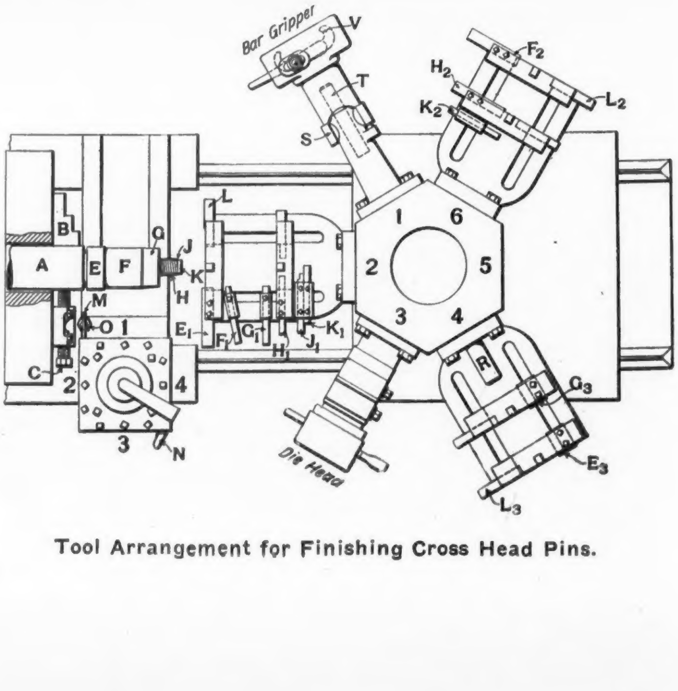
The piece being brought approximately to size, the surfaces F and H are next brought to exact size. This is done with the cutters F-2 and H-2 in box tool on face 6, main turret. Cutter K-2 faces the end K of the piece and at the same time gages the length of the pin; L-2 acts as a back rest for supporting.

Next, the box tool on face 4, main turret, is swung into position and the cutters G-3 and E-3 bring surfaces E and G to correct size and taper; the arbor R is arranged as a gage to determine the proper location of the tapered surfaces, thus insuring duplicate work when cutters E-3 and G-3 are once properly set; L-3 is a back rest.

All surfaces on the pin having thus been brought to size,



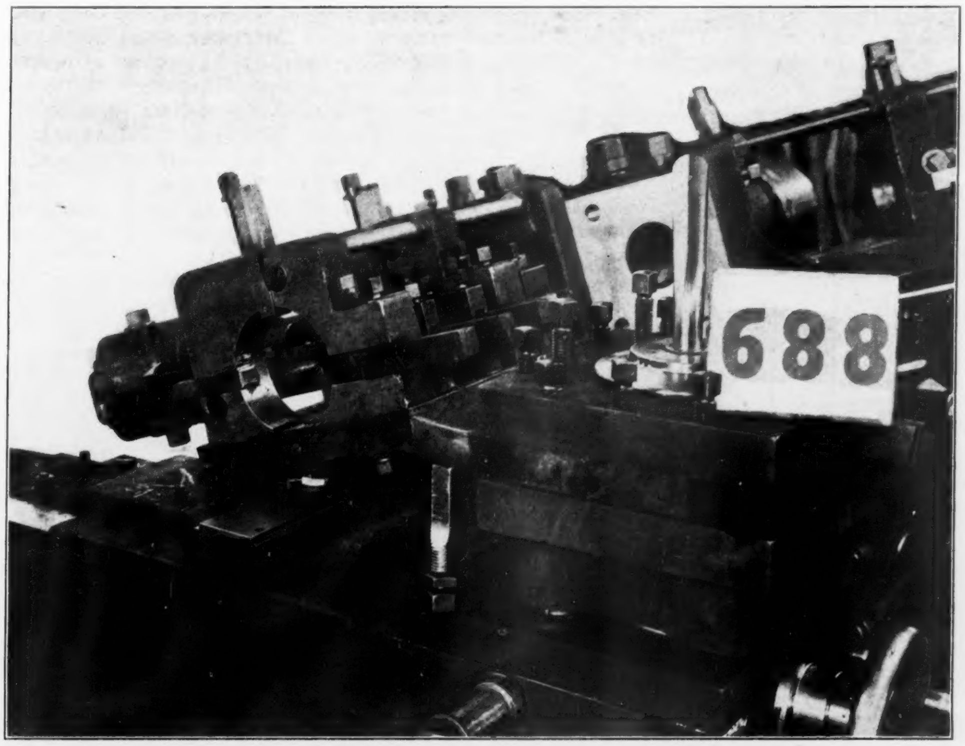
Gisholt Big Bore Lathe.



Tool Arrangement for Finishing Cross Head Pins.

the next operation is the cutting of the thread, which is done with the die head on face 3 of the main turret. This completes the piece and the tool post cutting off tool M, supported by post O, is then used for cutting off.

After the piece has been cut off the jaws and blocks are loosened and the bar gripper shown on face 1 of the main turret is swung into position. This bar gripper consists of a pair of self-acting jaws, shown at V, for gripping the piece and drawing it out, and an arbor at T for pushing the piece back to the desired length. The operation is as follows: By a rapid traversing device the bar gripper is brought rapidly to the piece and the self-acting jaws V grip the stock firmly; then by operating the turret rapid traversing device, the bar is drawn out to approximately the proper length. The jaws V are then released and the forward half of the bar gripper is swung upward at right angles on the hinge S, thus exposing the arbor T which is used to push the piece back to proper length for the next pin.



Turret of Gisholt Lathe.

Relation of Rates to Commodity Costs.

BY C. S. SIMS.
Second Vice-President Delaware & Hudson Co.

Logan G. McPherson has published a series of very interesting articles under the heading, "Food Supply for New York City." Mr. McPherson showed that the freight rate charged by the railroads rarely enters into the cost paid by the public for food, clothing or what may be termed living supplies. This statement, being accompanied with some facts and figures, leads me to have tabulated or worked out the actual cost or payment to the railroads on a number of articles used commonly by the people, and the results are as follows:

FLOUR.

Flour moving from Minneapolis to Albany, a distance of 1,346 miles, in barrels of 200 lbs., each barrel will make 235 one-pound loaves of bread, the rate per 100 lbs. being 24½c. The freight rate on the flour necessary for one loaf of bread is 21 hundredths of a cent. This loaf of bread will sell at retail for from five to seven cents.

DRESSED MEAT.

Chicago to Albany, a distance of 925 miles, the freight rate is 43 cents per 100 lbs., or 43 hundredths of a cent per pound. These meats will retail at from 11 to 25c. a pound, while the freight rate is less than one-half cent a pound.

PORK.

Omaha to Albany, a distance of 1,428 miles, the rate is 52c. per 100 lbs. Chicago to Albany, a distance of 925 miles, the rate is 29c. per 100 lbs., making the freight rate per pound 29 hundredths of a cent. The retail price of pork will average six or seven cents a pound, while the freight rate is less than one-third of a cent a pound.

SALMON.

From San Francisco to Albany, a distance of 3,503 miles, the rate is 75c. per 100 lbs. A case of salmon, containing four dozen cans, weighs 70 lbs. This makes the freight rate on a can of salmon one and one-tenth cents. Alaska salmon sells at 15c. a can, Columbia salmon at 25c. a can.

SUGAR.

New York to Chicago, a distance of 988 miles, the rate is 26c. per 100 lbs., or 26 hundredths of a cent per pound. Sugar retails usually at about five and one-half cents a pound.

CANNED GOODS.

Milford, Delaware, to Albany, a distance of 414 miles, the rate is 18c. per 100 lbs. Succotash, peas and corn weigh 40 lbs. to the case of two dozen cans, which makes the freight rate three-tenths of a cent per can. Succotash and corn sell for about 12½c. a can, while peas sell for about 19c. a can.

Tomatoes, average weight, per case of two dozen cans, 68 lbs., making the freight rate five-tenths of a cent per can. The average price is about 14c. a can.

BANANAS.

Philadelphia to Albany, a distance of 230 miles, the rate is 25c. per 100 lbs. Bananas weigh about 41 lbs. per bunch, and there are twelve dozen bananas to a bunch, making the freight rate 10¼c. per bunch, or 85 hundredths of a cent per dozen. Bananas retail at from 12 to 20c. a dozen.

LEMONS.

From San Francisco to Albany, a distance of 3,503 miles, the rate is $1.15 per 100 lbs. The average weight of a case of 25 dozen lemons is 85 pounds, making the freight rate on a dozen lemons three and nine-tenths cents. Lemons sell at about 25c. a dozen.

BEER.

Milwaukee to Albany, a distance of 1,010 miles, the rate is 29c. per 100 lbs. A half barrel, which will contain eleven dozen bottles, weighs 190 lbs., making the freight rate per bottle 41 hundredths of a cent. Beer retails at from ten to fifteen cents a bottle.

MINERAL WATER.

Albany to Milwaukee, a distance of 1,010 miles, the freight rate is 24c. per 100 lbs. Twelve bottles weigh 56 lbs., making the freight rate one and one-tenths cents per bottle. The retail price is from ten to twenty cents a bottle.

OIL.

Oil City to Albany, a distance of 513 miles, the freight rate is 15c. per 100 lbs. The weight of a gallon is 6.4 lbs., making the freight rate per gallon 96 hundredths of a cent. Oil sells at about 12c. a gallon.

CLOTHING.

Boston to Chicago, a distance of 1,11[illegible] miles, the rate is 75c. per 100 lbs. An average suit of clothes weighs 5½ lbs., or there are 18 suits of clothes to a hundred pounds. This makes the average rate on a suit of clothes 4.1c.

The average weight of an overcoat is 8 lbs., making the freight rate on an overcoat 6c.

A suit of clothes or an overcoat will commonly retail at about $15.

HOSIERY.

Boston to Chicago, a distance of 1,114 miles, the rate is 75c. per 100 lbs. The average weight of a case containing 80 dozen stockings is 170 lbs., making the freight rate 1.59 per dozen. Stockings retail at 25c. a pair, or about $2.25 a dozen.

KNIT GOODS.

Albany to Chicago, a distance of 925 miles; the rate is 60c. per 100 lbs. The average weight of a case containing 30 dozen, or 360, is 340 lbs., making the average freight rate per dozen six and eight-tenths cents, or per garment fifty-seven hundredths of a cent. The retail price per garment is 50 cents.

SHIRTS, COLLARS AND CUFFS.

Troy to Chicago, a distance of 925 miles; the rate is 60c. per 100 lbs. The average weight per dozen of four-ply collars is 16 ounces; the average weight per dozen of cuffs is 24 ounces; the average weight per dozen of shirts is 13 lbs., making the freight rate one-twentieth of a cent per collar, two-twenty-fifths of a cent per pair of cuffs and three-fifths of a cent per shirt. The average selling price of collars is 12½ cents each; cuffs, 25 cents per pair; shirts, about a dollar apiece.

SHOES.

Boston to Chicago, a distance of 1,114 miles; the rate is 75 cents. The average weight of a case containing 32 pairs of men's shoes is 100 lbs.; the weight of a case containing 60 pairs of women's shoes is 100 lbs.; the weight of a case containing 72 pairs of children's and misses' shoes is 100 lbs., making the freight rate on a pair of men's shoes two and thirty-four hundredths cents; on a pair of women's shoes one and twenty-five hundredths cents, and on a pair of children's or misses' shoes one and four hundredths cents. These shoes will sell, men's at $3 a pair, women's at $2 a pair and children's at $1.50 a pair.

SOAP.

Cincinnati to Boston, a distance of 989 miles; the rate is 29c. per 100 lbs. There are usually 100 cakes of soap in a box; they average six ounces to a cake and a box weighs 44 lbs., making the freight rate twelve hundredths of a cent per cake of soap. Soap retails at from 5 to 10 cents a cake.

The above illustrations clearly show that Mr. McPherson's statement that rarely if ever does the freight rate enter into the cost of the necessities of life, is true; that is, the cost of the commodity to the consumer would be no more or no less were the railroad to move the article absolutely without any charge.

The freight earnings on the railroads of the United States during the year 1906 were $1,659,925,643, and if 10 per cent. could have been added to the average freight rate, its effect to the consumer would not have been noticeable and would not have changed the price that he pays for any of the necessities of life. It would have yielded the railroads an additional income in net earnings of $165,992,564.30. This sum of money could have been used to very great advantage in the building of additional second track, the installation of automatic block signals, the abolition of dangerous highway and street crossings, the installation of interlocking and the many other devices which would have added to the safety of operations of the railroads.

The installation of automatic signals costs less than $2,000 a mile, so over 80,000 miles of the 225,000 miles of American railroad could have been equipped with automatic signals yearly, and in three years, with an increase of 10 per cent. in the freight rates, the entire mileage could be so equipped. To-day less than 10 per cent. of the mileage of American railroads is equipped with automatic signals.

This same increase of 10 per cent. in the average freight rate—which would not change the price the people pay for their commodities, nor would it be noticeable—would provide enough money to eliminate about 16,500 dangerous highway crossings yearly at an average cost of $10,000 apiece.

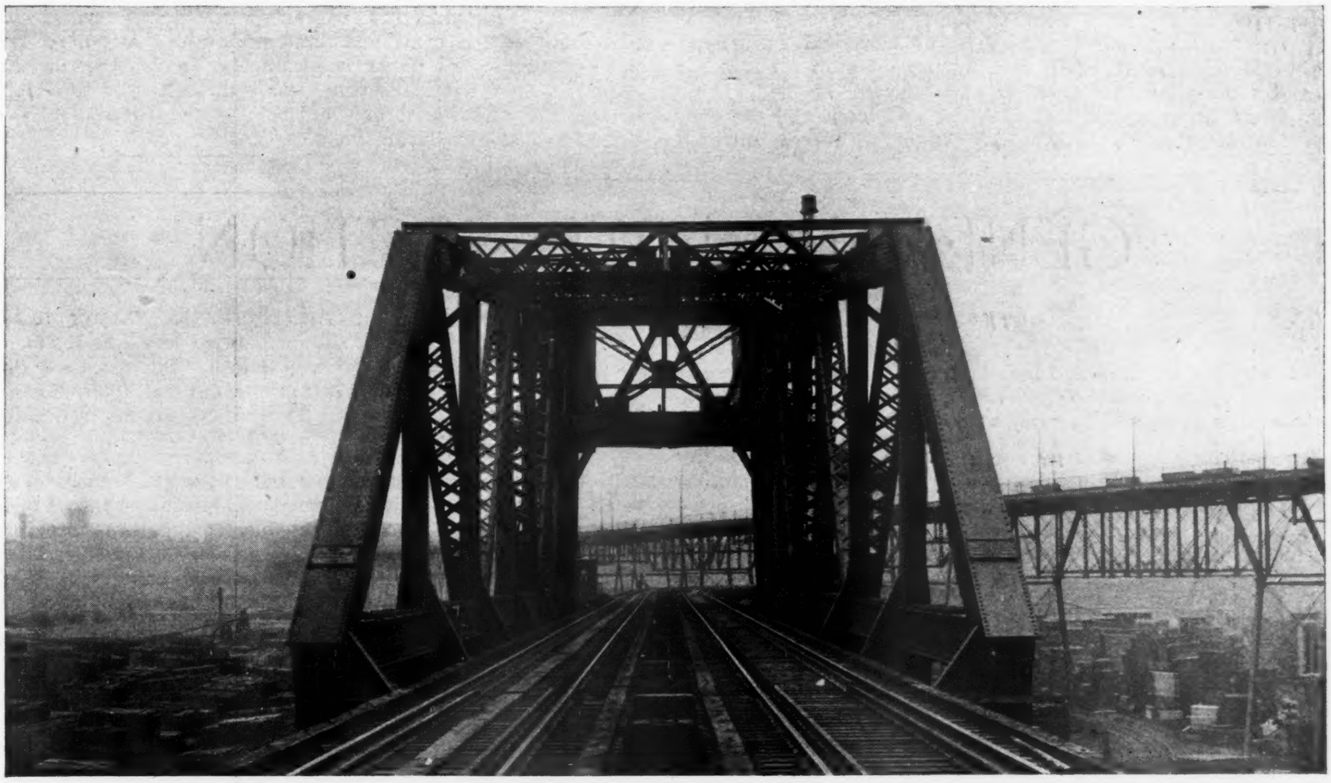
Scherzer Bascule Span at Cleveland.

The New York, Chicago & St. Louis recently rebuilt the long viaduct and draw carrying its track over the valley and channel of the Cuyahoga river at Cleveland, Ohio, the same having been completed and placed in service early this year. The viaduct has a total length of nearly 3,000 ft. and is about 60 ft. high. It consists of deck plate girder spans supported on steel towers, varied by two through truss spans, three deck trusses, one half-through plate girder span and a Scherzer rolling lift span across the river channel, the base of rail on the draw span being 70 ft. above the water. All the new

Scherzer Bridge Partly Open.

work was done while maintaining railroad traffic, the bascule span being erected in the open position so as not to interfere with railroad traffic or navigation. The old swing bridge which was replaced was operated during the reconstruction by cutting off several panel lengths, counterweighting the shortened arm and resting it upon temporary pile supports in front of the tower supporting the bascule span. One of the old channels was thus left entirely free for navigation.

The bascule span is a double-track, single-leaf through bridge 160 ft. long, center to center of bearings and 29 ft. 6 in. wide center to center of trusses. The clear channel for navigation allowed by the new bridge is 120 ft. measured at right angles to the channel, which makes an angle of 62 deg. 30 ft. 30 in., with the center line of the bridge. The track girders upon which the bascule span rolls are supported by a steel tower 48 ft. 9 in. high from masonry piers to the tops of the tower posts, the track girders having a depth of 10 ft. The tower posts are vertical front and rear, with a side batter of 1 in 12. The front end of the bascule span when closed is carried by the deck truss fixed approach span, the piers sup-



Portal View of Scherzer Bridge.

Scherzer Bridge in Closed Position.

porting this span being of concrete to the full height of the under side of the trusses, which have a depth of 20 ft. The bridge is operated by two direct-current electric motors of 50 h.p. each, the motors being placed on the moving leaf and moving the bridge through a shaft attached to pinions engaging in racks placed on fixed supports outside of each truss. The motors are worked from controllers in the operator's house and are equipped with solenoid brakes directly attached thereto. The bridge is also controlled by an auxiliary mechanical band brake worked by foot power from the operator's house. There is also a small gasolene engine auxiliary to operate the bridge in place of hand power should there be any trouble from defective current or electrical equipment. There is mechanical equipment in the operator's house for working the railroad signals at each end of the bridge, this equipment being interlocked with the end latch and the electric controller so that the bridge cannot be moved until all of these signals have been set at "danger." The end latch maintains the bridge in the closed position and is strong enough to resist the full power of the main operating plant. The rail locks are worked by a small independent electric motor in the operator's house.

The entire work was designed in accordance with the general specifications for steel bridges, 1904, of the New York, Chicago & St. Louis, and was executed under the charge of the engineering department of the railroad company, E. E. Hart, Chief Engineer, and A. J. Himes, Assistant Chief Engineer. The Scherzer Rolling Lift Bridge Co., Chicago, designed the superstructure, operating machinery and electric equipment of the draw span and maintained a general consulting engineering supervision during its construction and erection. The superstructure was fabricated by the King Bridge Co., Cleveland, and erected by the Pittsburgh Construction Co., Pittsburgh, Pa.

GENERAL NEWS SECTION

NOTES.

At Livingston, Mont., June 1, seven overland passenger trains, carrying about 1,000 passengers, were delayed by washouts, with a prospect of having to wait two or three days.

The state of Massachusetts has passed an employers' liability act, applicable only to railroad corporations, which is similar to that passed last month by Congress. An employee injured as a result of the negligence of a fellow-employee, shall not be deemed to have assumed the risk of such injury.

At St. Louis, May 19, Judge Wright, in the Federal Court, decided against the government in a suit to punish the National Stock Yards Co. for keeping cattle in cars more than 28 hours, holding that as the stock yards company is not a common carrier, it is not subject to regulation in this respect under federal laws governing interstate commerce.

Near Cascade, Mont., on the night of May 30, a passenger train of the Great Northern was stopped by masked *boys*, who robbed the passengers of their valuables. The express messenger was not molested. The robbers spent an hour at their work and compelled the conductor to assist them in collecting their booty. They were captured, and found to be 15, 16, 17 and 18 years old.

The Illinois Central uses a telephone line for all of the train despatching on the line between Chicago and Kankakee, Ill., 55 miles (double track), and has done so for the past three months. The operators use transmitters and receivers so arranged that both hands are free to use in writing. The road is trying two different types of selector apparatus for calling stations on telephone lines.

The Pennsylvania Railroad during the past four years has taken out 1,078 facing-point switches on its lines east of Pittsburgh and Erie. Over 200 of these were at interlocking plants. Of the 868 hand-operated facing-point switches taken out only 125 were replaced with trailing switches, the rest being abolished. During these four years 409 new connections had to be made to private industries, and the length of running tracks was increased from 7,599 miles to 8,114 miles. In the building of this new main track and the 409 siding connections 1,094 facing-point switches were installed, but all of them were interlocked.

Through passenger service between Chicago and Savannah, Ga., over the Illinois Central and the Central of Georgia, was opened on Saturday, May 30. A special train carrying several officers of the Illinois Central, including I. G. Rawn, vice-president; J. M. Dickinson, chief counsel; L. C. Fritch, assistant to the president; J. F. Titus, assistant to the president, and C. F. Parker, purchasing agent, left Chicago at 2.30 p.m. on May 29 and arrived at Birmingham at 2 p.m. the next day. The officers were met by representatives of the city council and the Commercial Club of Birmingham. Mr. Rawn responded to the speeches of welcome. On Saturday evening a banquet was given in honor of the visitors. The first Illinois Central passenger train left Birmingham for Chicago at 2.30 p.m. on May 30. Through freight service has been going on over the new line for more than a month. The Mobile & Ohio will use the new line of the Illinois Central from Corinth, Miss., to Birmingham, thereby gaining its first entrance into Birmingham.

Prof. Henry C. Adams, who for two years has been in charge of the work of formulating a uniform system of accounts for all carriers subject to the provisions of the Interstate Commerce law, is preparing to turn over the results of his labors to the commission and to return to the University of Michigan. Professor Adams obtained leave of absence of two years from the university in order to accept the appointment to formulate the accounting system. This task is now practically done. The commission expects to retain Professor Adams in the same capacity in which he was employed before the passage of the Hepburn act. He then divided his time between Ann Arbor and Washington, and had a general supervisory charge of the statistics as kept by the commission. This work he will continue to do. Charles A. Lutz, formerly assistant comptroller of the Louisville & Nashville, has been appointed to take charge of the bureau of expert examiners of the Interstate Commerce Commission. These examiners, of which there will be about 80 at the start, are to supervise the bookkeeping of the railroads, making such inspection as may be necessary to be assured that the accounts are kept according to the requirements of the law.

The Illinois Central and the Chicago & Alton railroads have filed applications in the United States Circuit Court for injunctions restraining the Interstate Commerce Commission from putting in force an order recently issued directing the railroads to adopt a new system of coal car distribution. The order which the roads seek to have set aside becomes effective July 1, and directs that in distributing coal cars to mines along their lines, the railroads shall take into account all cars in use on their lines, including those of foreign railroads, leased or private fuel cars and fuel cars used for the private service of the home road. The action of the commission followed a suit before that body brought by the Illinois Collieries Company, in which it was charged that certain mines obtained the use of all classes of cars, while the defendant was compelled to be content with such cars as were available. It is maintained by the railroads in their applications that the commission is without jurisdiction; that there never have been any unjust discriminations in the distribution of coal cars, and that such discriminations are impossible because the foreign, leased or private cars are used only in hauling the fuel supplies of the railroads.

A suit has been begun by the Chicago & Alton to test the legality of an order issued a year ago by Postmaster-General Cortelyou changing the divisor used in computing the weight of the mails. The Alton asks for $9,000 back pay. Other railroads are awaiting the outcome of the suit, and if it is decided in the Alton's favor will present claims amounting to

$4,000,000. Until about two years ago the Post Office Department weighed the mails for a week and then divided the total by six, on the assumption that mail was not carried on Sundays. The daily average thus found was used to compute the average weight of mail carried in a month or a year. It was claimed in Congress that this method was unjust to the government, and Congressman Murdock introduced an amendment to the Post Office Appropriation bill to alter the system. The amendment failed of adoption and the matter dropped; but just before leaving the Post Office Department to become Secretary of the Treasury, a year ago, Mr. Cortelyou issued an order making seven instead of six the divisor to be used in the computation of the annual weight of the mails, and by so doing altered a practice of thirty years' standing. The railroads protested vigorously at the time, and ever since have regularly filed claims for the excess payments which would be due them were the old divisor still retained.

The railroad committee of the Massachusetts legislature, after many weeks of hearings, has reported a bill to regulate the relation of the Boston & Maine to the New York, New Haven & Hartford. Its principal feature is a clause permitting the New Haven road to hold its Boston & Maine stock till July 1, 1910, with the right to take any new stock proportionally assigned to it which may be issued by the Boston & Maine and with the right to take dividends, but without the right to vote on it, which right is to be exercised by the state railroad commissioners. The general features of the bill prohibit all merging of one railroad corporation into another without the consent of the legislature. The railroad commissioners are to report what course regarding the situation will best protect the interests of the state and also as to what disposal shall be made by the New Haven road of its Boston & Maine stock, the report to be made to the legislature on or before January 12, 1910. Chairman Walker, of the railroad committee, says that the proposed act is not compulsory; it is a voluntary contract between the railroad and the state. The company must vote (this month) whether it will accept it. If it refuses to do so, then it will remain for the law to take its course. According to the opinion of the Supreme Court the Boston & Maine stock is held illegally, and the New Haven must stand the risk as best it can.

TRAFFIC NEWS.

The new tariff does not apply to Utah wool, although the tariff men are working on one which will care for wool from Utah and Idaho and points on the Oregon Short Line.

Responding to a request by the State Railroad Commission of Montana the Northern Pacific has established a new timetable providing for increased passenger train service in that state.

The Traffic Club of New York has passed a vote under which the officers of the club will seek to have a conference with the presidents of the trunk line railroads for a full and free discussion of the merits of any proposed increase in rates.

The executive committee of the Western Passenger Association decided at a meeting in Chicago on May 28 to refuse the request of the Chicago Association of Commerce for special rates for merchants' meetings in Chicago during the current year.

The Union Pacific has notified its connections of a reduction of the bridge arbitraries, at Council Bluffs and at Portland, Oregon. Hereafter the passenger arbitraries at Council Bluffs will be 15 cents one way and 30 cents for the round trip. At Portland 30 cents one way and 60 cents for the round trip.

The Traffic Club of Chicago had its last weekly luncheon of the season at the Grand Pacific Hotel, in Chicago, on May 28, the entertainment being provided by members. The entertainment committee has arranged for a golf tournament, which will take place on June 18 at the links of the Exmoor Club at Highland Park, Ill.

Railroads serving furnaces and iron mills find hopes of an increase in traffic in the announcement within the last two weeks of increased sales of pig iron, the quantity sold in this time being reported as over 600,000 tons. Thus far no ore has been shipped from the Lake Superior region this season, although navigation on the lakes has been open for more than a month.

The railroads have appointed an executive committee on uniform classification, of which C. C. McCain, chairman of the Trunk Line Association, New York, is chairman. This executive committee, whose headquarters will be in New York, is to appoint and supervise the work of a working committee, with headquarters in Chicago, which will undertake the work of formulating a uniform classification.

The Louisiana State Railroad Commission, on the application of the New Orleans Board of Trade, has issued a rule requiring shipments of freight returned to the sender, either in whole or in part, to be carried at half price, and this privilege must be granted for a whole year after the shipment is made; moreover, in the case of agricultural implements and certain other articles it shall extend over two years.

The Department of Agriculture reports that the area planted to cotton in the United States this season is about one-tenth of 1 per cent. (0.1) greater than the area planted last year, thus indicating an area of 32,081,000 acres, as compared with 32,060,000 acres planted last year. The condition of the growing crop on May 25 was 79.7 per cent. of a normal, as compared with 70.5 and 84.6 per cent. at corresponding dates in 1907 and 1906.

The lines belonging to the transcontinental freight bureau have decided to eliminate from their tariffs Rule 4, providing that 20 per cent. over the regular rate shall be charged when goods are shipped at carrier's risk. Probably the Western Trunk Line Committee will also abolish the rule as the Burlington, the Rock Island and the Missouri Pacific have notified the chairman of the committee that they will not enforce it. Many shippers have protested against the rule.

The lumber manufacturers' organizations of the Northwest have sent a circular letter to 2,000 members and representatives of commercial organizations in all parts of the United States requesting them to urge the national conventions of both leading political parties to insert in their platforms planks favoring legislation by Congress to give the Interstate Commerce Commission power to restrain proposed changes in rates pending investigation of their reasonableness.

At St. Louis the railroads which are carrying on the legal contest against ticket scalpers have taken action to test the validity of the law under which scalpers are punished for violating injunctions by only a small fine. The case is that of E. J. Gildersleeve, who was fined $50 and sentenced to 10 days in jail. In transferring the case to the first division of the Supreme Court, to be heard by the full bench next October, Judge Valiant said that the position of the railroad appeared to be sustained by the recent decision in the Sheppard case, 177 Missouri, page 205.

At Los Angeles, Cal., last Monday, a Federal grand jury returned indictments against the Southern Pacific Company for alleged rebating. Twenty-nine counts are included in the three indictments, citing specific instances of alleged unlawful refunding of charges. Officers of the railroad company have been summoned to appear in court June 15. The charges relate to shipments of oranges and lemons from Riverside, Cal., to various eastern cities, and also on shipments of rice from San Francisco to Los Angeles, and on shipments of hides from Texas and Arizona points to Los Angeles.

The rate committee of the Texas & Louisiana Sawmill Association met at Beaumont, Texas, on May 25 and voted to employ counsel to take action before the Interstate Commerce Commission or in the federal courts for the purpose of securing a reduction in rates on lumber from points west of the Mississippi river through the Cairo (Illinois) gateway to the east. The main complaint is against advances which were made at the time the advance of 2 cents per 100 lbs., a few years ago, in rates on lumber from the south, and which was held excessive and illegal, as to the territory east of the Mississippi river, in decisions which were sustained by the United States Supreme Court—the so-called "yellow pine lumber cases."

The Pennsylvania railroad reports that up to Monday morn-

ing of this week 7,219,297 quarts of strawberries had been shipped this season from the Maryland-Delaware peninsula by the Delaware division of the Philadelphia, Baltimore & Washington Railroad, as compared with 1,160,713 quarts for the same period of last year. The farmers now receive cash for their berries, a great advantage over the old scheme of shipping on consignment. This year refrigerator cars are supplied by the railroad company. The private refrigerator cars formerly used cost the shippers from $5 to $25 more per car than they pay under the present plan. Some 542 carloads had been shipped this year in Pennsylvania Railroad refrigerator cars. The town of Bridgeville, Del., one day last week shipped 74 cars, and is now sending three solid trains a day. At the present time about 100 buyers from Boston, Detroit, Buffalo and other cities are in Bridgeville, while about 100 resident buyers represent consignees at other points. About 40 per cent. of the shipments have been sent to New England and 40 per cent. to New York City.

The Union Pacific has issued a new tariff on wool from points east of Utah, effective June 5, in which there is a provision for allowing wool in carloads to be stored in transit at Omaha when originating at stations in Wyoming on Union Pacific, Colorado & Southern, or Colorado & Wyoming; in Colorado, on Union Pacific, Colorado & Southern, Colorado Midland, Colorado & Wyoming, Colorado & Southwestern, Denver & Rio Grande or Great Western; in Nebraska, on Union Pacific; in New Mexico, on Colorado & Southern, Denver & Rio Grande and the Santa Fe Central; also from Dragon, Utah, on the Uintah. The ultimate destination of the wool must be a point on or east of the Mississippi river. On delivery to the warehouse in Omaha, the charges will be collected at tariff rates from point of origin to the Mississippi river. When the weight of shipment sent east exceeds the weight of shipment to Omaha, the excess will be charged for at tariff carload rate applying from Omaha to destination. In the collection of charges at Omaha and rebilling from Omaha, the minimum carload rate authorized by the tariff must be observed. These arrangements will apply to wool held in storage in Omaha not to exceed 12 months. All wool held over that time will be treated as a local shipment to and from Omaha. The Union Pacific will not absorb any switching charges on wool shipped to Omaha for storage.

Standard Oil Hearing.

Testifying as to the reduction in hot journals resulting from the use of Galena oil, Mr. Walsh said that on the Pennsylvania Lines East of Pittsburgh following the application of Galena, the number of hot boxes was reduced 200 a day, thereby effecting a saving of $150 daily.—*Wall Street Journal.*

"But we raised the rate for the good of the public," said the railroad magnate.

"Couldn't you make that a little clearer?" ventured the spokesman of the committee.

"Why," continued the magnate, "people who can't afford to travel under the new tariff will save money, and we will run fewer trains, without diminishing the total of receipts."

"But where's the advantage to the road?"

"Fewer trains, less axle grease. The public, my dear sir, has no idea, positively it hasn't, as to the cost of axle grease." —*Philadelphia Ledger.*

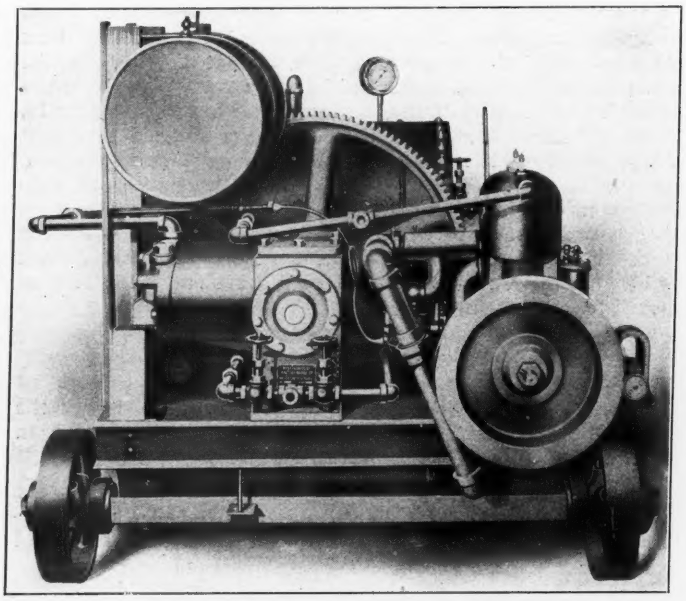
Co-operation Between Carriers and Shippers.

The Traffic Club of Pittsburgh at a special meeting on May 11 resolved that:

Whereas, There is a noticeable growing tendency on the part of some interstate carriers to discontinue supplying shippers with copies of freight tariffs, supplements and re-issues by discontinuing the mailing list, and in other instances to discontinue for reasons of economy or other reason, the compilation of numerous tariffs in one book, which latter have been of material advantage to shippers and to initial line agents, particularly where book rates have been used in combination, to make through rates. And since, under the ruling of the Interstate Commerce Commission and of the courts, shippers are now charged directly with the knowledge of what the legal rates of freight are, even though they have no voice in the making or publication of them, this is unfair to shippers. Therefore, the Traffic Club of Pittsburgh express its disapproval of any actions or contemplated actions on the part of the interstate common carriers which tend to make it more difficult by abolition of compiled books of freight rates or discontinuance of the mailing list, to ascertain the legal rates of freight than it had been prior to April 1. Because of the broad mutual interest that should exist between the shipping public and the carriers, it should devolve upon the latter as a moral, if not a legal duty, to continue to assist shippers at least to the same extent that they have in the past, and if possible, in the future to even a greater extent. It is recommended that the interstate carriers continue to keep shippers who have heretofore had that privilege, upon their mailing list for tariffs, because with the volume of business now transacted in this country, it is impossible and impracticable for shippers generally to obtain through rates of freight from tariffs posted in the freight houses or from local agents.

Gasolene Driven Portable Air Compressor Plant.

The illustration shows a portable plant designed for use in construction work at points where no power supply is available. The compressor in this plant is driven by a gasolene engine, which takes the place of the electric motor ordinarily used.



Westinghouse Air Compressor Plant.

All the details, it will be observed, are of standard make. The plant was assembled by the Link-Belt Engineering Co., Philadelphia, Pa., to be used in connection with that company's own construction work.

The outfit is mounted on a truck made of steel channels and partly covered with sheet iron. A D-2 water-jacketed compressor is connected by gear and pinion to the engine shaft through a friction clutch. The engine is a Lackawanna two cylinder, 5 h.p., marine type gasolene engine. The gasolene is stored in the small tank supported above the air pump. The carburetor is on the truck between the engine and pump. A small magneto dynamo, which furnishes the sparking current, rests on a sheet iron platform and is driven by frictional contact with the rim of the engine fly-wheel. Both engine and compressor are water cooled from the same supply, but the flow of water to each may be regulated separately by globe valves in each inlet branch. The air reservoir is 20½ in. x 36 in., with an approximate capacity of 10,400 cu. in. (6 cu. ft.).

The ratio of driving gear and pinion is such as to operate the pump at about 208 r.p.m. This particular plant, which has proved satisfactory for the purpose of the design, is typical of the ease with which the equipment may be modified for special purposes.

Portable Automatic Crank-Pin Truing Machine.

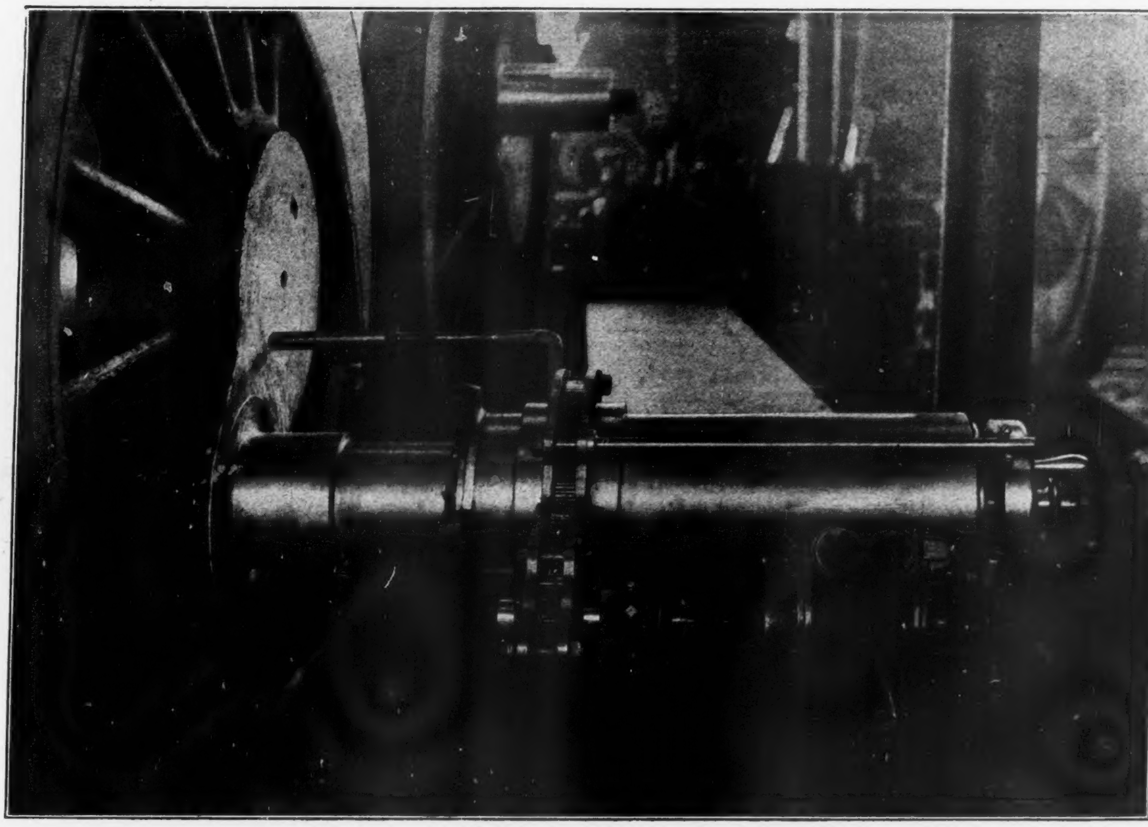
Truing crank-pins by the chipping and filing process is slow and expensive and seldom results in a perfectly round pin. Rather than do this, some shops remove the old crank-pin and replace it with a new one. Machines have been devised for truing crank-pins, but they have been unsatisfactory because of the need of many and careful adjustments, and because they depended, for their proper bearing, on the wheel being perfectly true, which is seldom the case. Machines which are bolted to the side of the wheel or hub will only square the pin with those parts. As they are seldom true with the wheel (on account of the distortion due to pressing on the wheel and shrinking on the tire) the pin cannot be trued in perfect alinement.

The crank-pin truing machine illustrated herewith takes its bearing directly on the pin, and as the crank-pin hole is bored after all other work on the wheel is done, the pin is in true alinement with the axle. This machine was designed by a railroad mechanic after several years study of the requirements and a careful investigation of the methods used in various shops throughout the country in an endeavor to avoid the features which made other machines objectionable. The machine which he produced has only four parts, each light enough to be easily handled by one man.

The illustration shows the machine connected to the crank-pin, ready for work. The barrel of the machine is first secured firmly to the gudgeon screw at the end of the crank-pin by two handles. These are then removed, and the sliding sleeve is placed on the barrel. Attached to this sleeve are lugs containing the necessary tools for roughing, finishing and filleting the crank-pin. These tools are made of high-speed steel. The gearing wheels and casing are then slipped over the two feather keys. The forward or feed motion of the sleeve is either automatic or manual, there being a hand wheel for the latter. It is unnecessary to stop the machine to engage or disengage the gearing. The machine is driven by an air motor.

The machine can be adjusted to any pin having a threaded end by simply making a face plate to suit the pin and threading it to suit the extension. It is also an easy matter to drill the end of the crank-pins having collars, and insert a gudgeon screw to which the machine can be attached. The machine can be used in the roundhouse without removing the wheels from the engine, prolonging the life of rods and brasses. The breaking of many rods has been traced directly to the imperfect condition of the main crank-pin. It has been shown that if the main pins are kept in good condition, the front and back pins will need little attention and the number of broken rods lessen.

The machine takes but a short time to set up. The outside end of the pin, from which the gudgeon screw projects, never changes, thus providing an exact center. When the machine is screwed tight against the end of the pin, it is therefore perfectly square. The machine complete weighs 350 lbs., exclusive of the air motor. Any standard air drill or motor can be used to drive it. Jos. T. Ryerson & Son, Chicago, are the makers.



Ryerson Crank Pin Truing Machine.

Jamaica to the Grand Central in Half an Hour.

The connection between the Long Island third-rail system and the Interborough Subway at Flatbush avenue, Brooklyn, has cut down the time necessary to get from one's home to the city about 40 minutes a day in both directions. Following is a schedule showing the time of trains in minutes between various Long Island points and Interborough stations in Brooklyn and Manhattan, and the commutation fare per day (cents) including the Interborough fare of 10 cents:

From—	Borough Hall.	Wall Street.	Brooklyn Bridge.	G. C. Station.	Fare.
Jamaica	21	27	29	37	30
Far Rockaway	37	43	45	53	35
Garden City	36	42	44	52	35
Hempstead	39	45	47	55	37
Sea Cliff	49	55	57	65	40
Oyster Bay	63	69	71	79	43
Huntington	56	62	64	72	43
Northport	67	73	75	83	46
Rockville Centre	38	44	46	54	36
Babylon	59	65	67	75	45

This means that people can live on Long Island and reach the business section of Manhattan in the same time that one can who lives in Harlem or the Bronx.—*Ralph Peters, in New York Times.*

REPORT OF REVENUES AND EXPENSES OF CARRIERS FOR MONTH OF APRIL, 1908.

Name of road.	Mileage operated at end of month.	Operating revenues — Revenue, Freight.	Operating revenues — Revenue, Passenger.	Operating revenues — All other revenue from transportation.	Operating revenues — Revenue, operations other than transportation.	Total operat'g revenues.	Operating expenses — Maintenance — Way and structures.	Operating expenses — Maintenance — Of equipment.	Operating expenses — Expenses — Traffic.	Operating expenses — Expenses — Transportation.	Operating expenses — Expenses — General.	Total operating expenses.	Net operating revenues (or deficit).	Taxes.	Operating income (or loss).
Atlantic Coast Line	4,368	$1,548,160	$539,354	$157,099	$21,921	$2,266,534	$285,902	$361,755	$34,255	$806,246	$48,690	$1,536,848	$729,686	$98,339	$631,347
Boston & Maine	2,242	1,663,820	990,007	175,611	52,844	2,882,282	279,171	351,350	35,390	1,364,538	50,554	2,081,003	801,279	141,927	659,352
Central of Georgia	1,913	471,556	196,202	54,869	13,900	736,527	102,886	157,517	25,555	296,050	27,615	609,623	126,904	38,675	88,229
Central of New Jersey	667	1,593,534	358,007	2,832	24,188	1,978,561	159,357	302,848	21,158	497,322	32,418	1,013,103	965,458	187,554	777,904
Chesapeake & Ohio	1,839	1,331,668	297,118	80,047	10,020	1,718,853	197,289	337,809	36,659	530,135	39,057	1,140,949	577,904	67,820	510,084
Chicago & Alton	1,005	505,229	258,591	66,174	4,131	834,125	81,682	90,834	36,212	274,632	24,517	507,876	326,249	30,000	296,249
Chicago & Eastern Illinois	957	399,325	120,013	34,928	3,321	557,587	78,398	101,227	15,079	253,422	28,628	476,754	80,833	30,196	50,637
Chicago & North-Western	7,630	2,813,021	1,114,375	440,892	37,991	4,406,279	609,068	375,808	73,298	1,817,039	87,455	2,962,669	1,443,610	222,000	1,221,610
Chicago, Burlington & Quincy	9,022	3,822,440	1,350,170	447,052	67,314	5,686,976	1,878,433	899,156	132,218	1,915,731	153,150	4,978,688	708,288	201,100	507,188
Chicago, St. Paul, Minn. & Omaha	1,730	611,455	249,032	71,987	2,296	934,770	107,682	102,403	19,531	370,814	25,106	625,536	309,234	52,970	256,264
Colorado & Southern	1,248	448,002	108,304	44,411	2,669	603,386	95,046	118,234	15,027	194,768	22,308	445,382	158,004	20,090	137,914
Delaware & Hudson	845	1,302,849	175,989	30,824	17,963	1,527,625	145,696	230,868	13,724	560,479	33,062	983,829	543,796	35,000	508,796
Delaware, Lackawanna & Western	893	1,957,925	485,706	150,401	11,297	2,605,330	231,285	484,202	47,834	763,990	51,591	1,578,902	1,026,428	112,800	913,628
El Paso & Southwestern	865	424,308	86,739	19,654	3,800	534,501	64,317	79,438	8,130	165,691	14,434	332,010	202,491	12,828	189,663
Great Northern	6,663	2,433,483	797,441	225,828	26,729	3,483,481	604,233	526,605	67,651	1,141,472	63,967	2,403,928	1,079,553	175,405	904,148
Illinois Central	4,624	2,451,363	794,370	459,817	27,078	3,732,628	518,753	716,279	101,996	1,500,388	91,595	2,929,011	803,617	169,725	633,892
Kansas City Southern	827	466,493	93,676	53,878	9,678	623,725	67,924	66,323	19,803	220,360	23,698	398,108	225,617	29,564	196,053
Lake Shore & Michigan Southern	1,508	1,985,105	645,255	370,370	19,479	3,020,209	413,749	428,841	80,509	1,106,170	60,352	2,089,621	930,588	109,999	820,589
Louisville & Nashville	4,348	2,272,579	767,173	212,661	18,812	3,271,225	430,693	722,834	81,139	1,209,921	81,746	2,526,332	744,893	135,675	609,218
Maine Central	931	379,770	190,986	37,169	5,092	613,017	83,105	106,007	6,279	242,103	15,842	453,336	159,681	31,622	128,059
Missouri, Kansas & Texas	3,072	964,892	429,181	102,673	24,000	1,520,746	173,038	186,894	48,280	754,143	52,962	1,215,317	305,429	65,838	239,591
Mobile & Ohio	926	509,757	85,793	94,609	2,915	693,074	89,603	76,855	27,083	261,615	25,047	480,203	212,871	23,100	189,771
New York, Ontario & Western	546	556,689	84,782	21,435	2,452	665,358	73,380	83,328	10,108	238,344	13,674	418,835	246,523	9,000	237,523
Northern Pacific	5,617	3,540,674	1,364,501	244,168	48,708	5,198,051	556,411	631,217	67,496	1,613,637	69,030	2,937,791	2,260,260	181,932	2,078,328
Pennsylvania Company	1,414	1,796,633	486,672	270,924	16,998	2,571,227	273,967	466,718	59,550	1,057,560	70,752	1,928,547	642,680	132,060	510,620
Pennsylvania R. R. Co.	3,978	7,199,941	2,270,874	984,333	66,750	10,521,898	1,372,781	1,929,065	152,816	4,045,481	266,350*	7,801,693	2,720,205	174,339	2,545,866
Philadelphia & Reading	999	2,442,811	461,014	109,997	21,856	3,035,678	372,339	629,982	36,613	946,230	53,453	2,038,617	997,061	69,293	927,768
Phila., Balto. & Wash.	715	623,980	568,920	137,636	5,978	1,336,514	181,538	192,240	25,323	589,467	31,029	1,019,597	316,917	31,142	285,775
Pittsburgh, Cin., Chic. & St. Louis	1,472	1,442,282	527,914	269,994	11,274	2,251,464	238,377	432,860	61,489	895,719	58,662	1,687,107	564,357	103,250	461,107
Southern Railway	7,501	2,615,682	950,804	356,609	13,261	3,936,356	471,154	541,394	101,394	1,577,848	119,751	2,811,541	1,124,815	162,574	962,241
Texas & Pacific	1,885	603,629	223,352	58,164	9,117	894,262	190,630	139,555	15,886	443,148	33,713	822,932	71,330	28,539	42,791
Vandalia	829	368,144	162,981	77,116	3,095	611,336	63,498	116,279	20,617	273,451	19,748	493,593	117,743	22,605	95,138
Wisconsin Central	1,023	400,757	116,980	29,294	2,089	549,120	56,751	91,968	20,424	226,211	17,195	412,549	136,571	23,615	112,956
Yazoo & Miss. Valley	1,347	526,257	152,984	35,006	5,563	719,810	164,003	136,646	16,797	314,704	21,035	653,185	66,625	33,125	33,500

*Includes $35,200 canal expenses.

REPORT OF REVENUES AND EXPENSES OF CARRIERS FOR TEN MONTHS OF FISCAL YEAR 1908.

Name of road.	Mileage operated at end of period.	Operating revenues — Revenue, Freight.	Operating revenues — Revenue, Passenger.	Operating revenues — All other revenue from transportation.	Operating revenues — Revenue, operations other than transportation.	Total operat'g revenues.	Operating expenses — Maintenance — Way and structures.	Operating expenses — Maintenance — Of equipment.	Operating expenses — Expenses — Traffic.	Operating expenses — Expenses — Transportation.	Operating expenses — Expenses — General.	Total operating expenses.	Net operating revenues (or deficit).	Taxes.	Operating income (or loss).
Atlantic Coast Line	4,368	$ 5,096,193	$5,437,906	$1,362,304	$253,344	$22,149,747	$3,236,686	$3,604,847	$364,341	$8,449,205	$545,078	$16,200,157	$5,949,590	$874,339	$5,075,251
Boston & Maine	2,242	19,085,996	11,404,805	1,927,324	618,349	33,036,474	4,054,507	4,047,975	417,385	15,845,130	579,989	24,944,986	8,091,488	1,428,407	6,663,081
Central of Georgia	1,913	6,601,920	2,428,993	590,316	230,941	9,852,170	1,313,480	1,811,582	257,438	3,602,294	298,425	7,283,219	2,568,951	368,556	2,200,395
Central of New Jersey	667	14,613,543	3,946,478	34,991	338,121	18,933,133	1,980,247	3,102,781	268,871	5,387,894	333,162	11,072,955	7,860,178	990,714	6,869,464
Chesapeake & Ohio	1,839	16,704,204	4,425,210	858,363	114,441	22,102,218	2,508,484	4,639,814	395,835	6,737,265	366,745	14,648,144	7,454,074	678,200	6,775,874
Chicago & Alton	1,005	6,616,433	2,933,418	677,304	52,632	10,279,787	1,224,966	1,376,961	407,189	3,292,371	263,512	6,564,999	3,714,788	300,000	3,414,788
Chicago & Eastern Illinois	957	7,446,553	1,424,891	414,901	45,948	9,332,293	1,056,882	1,535,526	171,289	3,386,237	302,653	6,452,587	2,879,706	278,391	2,601,315
Chicago & North-Western	7,630	36,130,257	13,174,101	4,289,412	356,919	53,950,689	6,532,138	6,171,868	935,964	21,246,675	900,479	35,787,124	18,163,565	2,140,000	16,023,565
Chicago, Burlington & Quincy	9,022	45,311,477	15,676,637	4,894,588	554,513	66,437,215	11,137,062	10,610,172	1,295,998	21,392,514	1,477,707	45,913,453	20,523,762	2,011,000	18,512,762
Chicago, St. Paul, Minn. & Omaha	1,730	7,165,783	3,124,391	691,204	51,102	11,032,480	1,395,414	1,333,576	198,050	4,167,101	230,102	7,324,243	3,708,237	524,806	3,183,431
Colorado & Southern	1,248	5,552,174	1,355,543	348,305	39,874	7,295,896	970,332	1,235,898	142,400	2,366,596	239,551	4,954,777	2,341,119	198,138	2,142,981
Delaware & Hudson	845	13,691,055	2,501,227	348,019	143,734	16,684,035	1,335,686	1,971,323	173,797	5,848,013	306,841	9,635,659	7,048,376	368,837	6,679,539
Delaware, Lackawanna & Western	893	20,745,939	5,529,891	1,554,892	134,277	27,964,999	2,784,020	4,374,272	465,158	8,204,163	512,857	16,340,470	11,624,529	1,064,700	10,559,829
El Paso & Southwestern	865	5,346,664	930,817	216,964	43,556	6,538,001	763,748	1,288,339	78,708	2,289,684	169,163	4,589,642	1,948,359	90,025	1,858,334
Great Northern	6,663	35,302,509	9,407,786	2,212,694	170,155	47,093,144	7,625,588	6,986,246	624,690	14,496,795	610,095	30,343,414	16,749,730	1,984,792	14,764,938
Illinois Central	6,624	30,166,337	9,319,405	5,182,235	321,712	44,989,689	5,782,205	8,771,497	1,026,189	16,521,079	921,180	33,022,150	11,967,539	1,848,767	10,118,772
Kansas City Southern	827	5,815,663	1,103,640	553,752	90,629	7,563,684	786,664	1,062,658	223,316	2,657,259	227,650	4,957,547	2,606,137	224,010	2,382,127
Lake Shore & Michigan Southern	1,508	23,114,305	7,740,257	3,714,337	209,793	34,778,692	4,869,153	4,308,081	889,736	12,075,227	579,246	22,721,444	12,057,248	1,143,528	10,913,720
Louisville & Nashville	4,348	26,744,425	8,969,330	1,998,625	222,577	37,934,957	5,008,506	8,159,575	882,380	13,827,423	867,360	28,745,244	9,189,713	1,186,782	8,002,931
Maine Central	931	4,324,487	2,396,655	408,508	58,743	7,188,393	949,745	1,042,697	55,731	2,697,397	163,279	4,908,849	2,279,544	311,282	1,968,262
Missouri, Kansas & Texas	3,072	13,300,605	5,480,856	1,048,778	237,960	20,068,199	2,543,315	2,621,890	507,650	7,519,409	530,181	13,722,445	6,345,754	556,075	5,789,679
Mobile & Ohio	926	6,081,441	1,041,134	1,053,760	45,947	8,222,282	1,058,909	1,249,840	272,361	2,977,664	266,765	5,825,540	2,396,743	155,900	2,240,843
New York, Ontario & Western	546	5,098,534	1,322,207	235,408	32,309	6,688,458	825,397	1,131,239	103,666	2,339,611	131,156	4,531,069	2,157,389	142,284	2,015,105
Northern Pacific	5,617	40,468,014	15,359,852	2,604,793	461,013	58,893,672	6,575,399	7,335,020	670,459	17,811,810	738,768	33,131,456	25,762,216	2,061,276	23,700,940
Pennsylvania Company	1,414	27,937,359	5,959,024	2,754,467	268,680	36,919,530	4,299,598	6,568,396	630,871	13,628,775	736,101	25,863,741	11,055,789	1,351,501	9,704,288
Pennsylvania R.R. Co.	3,978	90,407,602	25,732,298	10,308,118	1,120,571	127,568,589	15,323,887	24,296,095	1,645,455	48,549,135	2,826,477*	93,080,539	34,488,050	1,743,393	32,744,657
Philadelphia & Reading	999	27,310,159	5,235,323	1,061,884	272,166	33,879,532	3,095,711	6,909,338	371,657	10,622,095	569,548	21,568,349	12,311,183	692,929	11,618,254
Philadelphia, Baltimore & Washington	715	6,461,751	6,070,353	1,391,356	97,999	14,021,459	1,768,716	2,410,356	233,423	6,122,884	281,116	10,816,495	3,204,964	311,418	2,893,546
Pittsburg, Cin., Chic. & St. Louis	1,472	19,528,246	6,074,611	2,894,485	168,040	28,665,382	3,624,905	5,333,531	629,390	10,405,838	563,453	20,557,118	8,108,264	1,056,357	7,051,907
Southern Ry.	7,501	29,401,857	12,231,993	3,446,880	260,787	45,341,517	6,255,108	8,142,339	1,096,410	17,669,037	1,305,064	34,467,958	10,873,559	1,694,623	9,178,936
Texas & Pacific	1,885	8,506,836	3,185,849	781,766	112,015	12,586,466	1,481,347	2,064,776	170,063	5,324,503	335,030	9,375,720	3,210,746	501,800	2,708,946
Vandalia	829	5,124,812	1,915,726	781,627	41,105	7,863,270	1,014,719	1,480,002	220,790	3,093,425	176,996	5,985,932	1,877,338	219,125	1,658,213
Wisconsin Central	1,023	4,559,332	1,286,831	353,079	26,252	6,225,494	657,954	888,300	209,402	2,358,797	191,059	4,305,512	1,919,982	270,446	1,649,536
Yazoo & Mississippi Valley	1,347	6,190,354	1,727,881	353,018	52,857	8,324,110	1,685,311	1,262,959	166,236	3,360,572	191,298	6,666,376	1,657,734	350,125	1,307,609

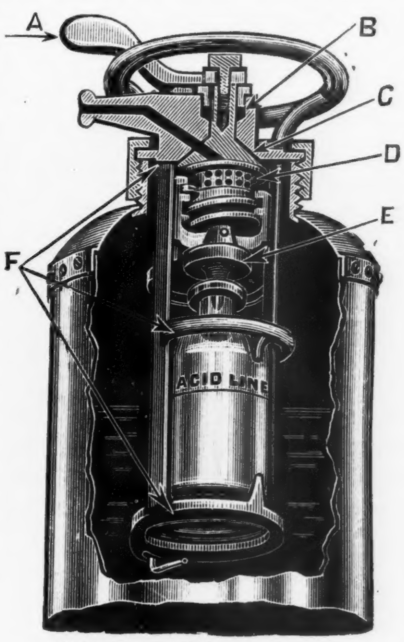
*Includes $539,489 Canal expenses.

New Use for Manganese Steel.

The Cutler-Hammer Clutch Co., Milwaukee, Wis., is using manganese steel discs for coil shields in its lifting magnets. This shield forms the under side of the lifting magnet, coming in contact with the pig iron and scrap metal being handled. It protects the coil and also has to be non-magnetic, so that the magnetic lines of force between the two poles shall be compelled to pass through the material which is lifted. Brass has heretofore been used for this shield. Manganese steel is non-magnetic and much harder than brass, so that it can stand the rough service to which it is subjected. These new shields were used on a number of magnets recently sold to steel mills in the Pittsburgh district.

The Utica Fire Extinguisher.

The Utica fire extinguisher is for use on electric or steam railroad cars. The particular feature of the extinguisher is that it has a stop-cock outlet in the cap, and by shutting off this stop-cock the passage to the nozzle is closed and also the stopple is held firmly in the bottle, so that the acid cannot mix with the liquid. To operate it, the stop-cock is opened and the extinguisher turned upside down. In the accompanying cut, A is the lever handle to the stop-cock, and E is the lead stopple. The face of this is beveled and ground to a true surface, making a tight joint with the top of the lip of the bottle, which is also ground true. The bottle cage is made of bronze in one piece with the top. This cage and the inside working parts of the stop-cock, as well as the inside of the tank, are thickly coated with a lead mixture to prevent corrosion. The packing, B, around the stem of the stop-cock prevents leakage if any liquid should get through the joint at C, which, however, is ground true and should make a perfect joint. The strainer D is over the outlet from the bottle to the tank.



Utica Fire Extinguisher.

This extinguisher is furnished either with or without hose. Among the electric railways now using it are the Utica & Mohawk Valley Electric, the electrified part of the West Shore, the Auburn & Syracuse Electric, the Indiana & Eastern, and the Fonda, Johnstown & Gloversville. It is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters. It is made by the O. J. Childs Co., Utica, N. Y., which also makes the Childs three-gallon fire extinguisher for use in passenger stations, freight houses, signal towers, etc.

Missouri Pacific for "Sunshine."

The Missouri Pacific has sent to its agents throughout the country a circular letter urging them to co-operate in promoting the movement started at St. Louis by the National Prosperity Association to "dispel the idea that this great nation is not at the present time prosperous." The letter is signed by B. M. Flippin, freight traffic manager; C. L. Stone, passenger traffic manager, and J. W. Higgins, assistant general manager. The letter declares that if every individual will recognize the fact that the resources of the country are unimpaired, "the wheels of prosperity will soon turn as rapidly as they ever did." The agents of the company are asked to solicit the support of the newspapers in their various communities for the prosperity movement, and to aid in the formation of clubs to become affiliated with the prosperity association.

Reunion of Railroad Men of Iowa.

A reunion of old railroad men of Iowa was held at Des Moines on May 26 and 27. Railroad officers and employees who have served on railroads in Iowa were in attendance as the guests of the Iowa Railway Club. The visitors were welcomed to the state and to the city by Warren Garst, Lieutenant-Governor of Iowa, and A. J. Mathis, Mayor of Des Moines. B. L. Winchell, President of the Rock Island Lines, made a brief address on existing railroad conditions, emphasizing the necessity of a fuller co-operation between the owners of railroad properties and those who are on the pay-roll—"every employee from the president up and down." Referring to the discussion over the proposed advance in freight rates, Mr. Winchell said that the real question was whether wages should be reduced or freight rates advance, and added:

"I believe the railroad employees of this country—a vast army of a million and a half of men—can settle this question with tradesmen and with the rate-making bodies of the states and of the national government. You have shown in the past that whatever you demand with united front will be granted. If you will realize now that this matter affects your future much more definitely than it does the future of the railroad companies, I believe you will take hold of it in the same vigorous way that you have handled other matters in the past. You have only to realize that it is your business, and not the business of the board of directors, in order to secure a satisfactory outcome."

Telegrams were read from W. C. Brown, Senior Vice-President of the New York Central Lines, and A. B. Cummins, Governor of Iowa, and General Grenville M. Dodge, of Council Bluffs, Iowa, sent a letter. The visitors were entertained at luncheon on May 26 and with a military parade and an exhibition fire drill.

A Fast Ocean Trip by a Disabled Vessel.

The Cunard steamship "Mauretania" reached New York on June 1 in next to the fastest record ever made over the long course from Queenstown, while using only three of her four propellers, the fourth having been disabled before the voyage was begun. The length of the long course, from Daunt's Rock to Sandy Hook light vessel, is 2,889 miles. The "Mauretania" made the trip in 4 days 21 hours 18 minutes, which is only 56 minutes behind the best record over the course, which was made by the "Lusitania," while it is 2 hours 41 minutes better than the best previous record of the "Mauretania" herself. The average speed was 24.64 knots an hour. From noon of May 30 to noon of May 31 the "Mauretania" covered 635 knots, averaging 25.5 knots an hour, which is said to be the best record ever made on the ocean.

INTERSTATE COMMERCE COMMISSION.

Through Lake-and-Rail Rates.

Benton Transit Co. v. Benton Harbor-St. Joe Railway & Light Co. Opinion by Commissioner Harlan.

The withdrawal of lake-and-rail rates for the winter during the period of closed navigation with the intention of restoring them with the opening of navigation in the spring was held not sufficient to take from the jurisdiction of the Commission a rail line which, like the defendants, lies wholly within one state, because during that limited time it has no connections by which it can actually engage in interstate traffic. The complaint in this case was filed the day after certain interstate rates had been suspended for the winter; but when the complaint came on for hearing the rates had been restored. Upon objection made that the Commission was without jurisdiction to proceed except upon a new or amended complaint the Commission held that, having jurisdiction when the complaint came on to be heard it, being an administrative body, ought not to delay the hearing upon a purely technical objection that did not reach the merits of the controversy. The Commission held that the answer to the question whether a satisfactory through route exists depends upon the facts and circumstances of each case. While the three steamboats of the Graham & Morton Line, with which the defendant now

has through routes and joint rates for the transportation of fruit from certain points in the state of Michigan by rail to Benton Harbor, Mich., and thence across Lake Michigan to Chicago, can doubtless carry all the fruit produced in the territory in question, its ability satisfactorily to handle the traffic is to be measured by the least adequate of its facilities. And if it cannot promptly deliver the traffic over its wharf at Chicago, and thus causes delays that result in financial losses to shippers, the through route by that line cannot be said to be satisfactory.

SUPPLY TRADE NOTES.

Richard C. Hall has been elected Secretary of the National Railway Materials Co., New York.

The Block-Pollak Iron Co., Chicago, has moved its general offices to 1534-35 First National Bank building.

Henry Floy, who has been consulting engineer in New York for the past ten years, has moved to new offices at 1409 City Investing building, 165 Broadway.

The Allis-Chalmers Co., Milwaukee, Wis., has opened an office at Birmingham, Ala. Seldon Jones is District Manager, with offices at 319-20 First National Bank building.

The Trojan Car Coupler Co., New York, has moved its Chicago offices from the Monadnock block to 912 New York Life building. S. T. Rowley continues as Chicago representative of the company.

C. R. Spare has been elected Vice-President of the American Manganese Bronze Co., 99 John street, New York, and is now at Holmesburg, Philadelphia, Pa., as General Manager of the works now in course of erection.

The Rockwell Furnace Co., New York, engineers and maker of metallurgical furnaces and fuel oil and gas burning appliances, has just been formed. The officers and employees of the company have been for a number of years with the Rockwell Engineering Co., New York.

James S. Watson, manager of the drive chain department of the Link-Belt Co., Philadelphia, Pa., has moved from the Philadelphia works to the company's chain making plant at Indianapolis, Ind. He will supervise the manufacture and direct the selling force handling the Renold silent and roller chains.

The Great Northern has ordered from the Allis-Chalmers Co., Milwaukee, Wis., a 22-in. x 44-in. x 22-in. heavy duty, cross-compound Reynolds-Corliss engine driving a 750 k.w. Allis-Chalmers engine-type alternator wound for 60-cycle, three-phase circuits, with exciter set and lighting transformers. The equipment is for a grain elevator at Superior, Wis.

A. M. Castle & Co., 55-59 Jefferson street, Chicago, announce that their business will in no way be interrupted or affected by the death of their late president, A. M. Castle. William B. Simpson has been elected President. He has been with the company for a number of years as Treasurer and Manager of Sales and for the past three years has been in charge of the business because of the ill health of Mr. Castle.

The Michigan Lubricator Co., Detroit, Mich., has an order for 55 triple bull's-eye lubricators to be shipped to the North British Locomotive Co., Glasgow, Scotland, for engines being built there for the Chilian State Railroads. The company has also furnished 40 four-feed bull's-eye lubricators for the Mallet engines now being placed in service on the Great Northern, which were built by the Baldwin Locomotive Works. It also has an order for 29 triple bull's-eye lubricators for the Grand Trunk.

The Bureau of Manufacturers, Washington, D. C., has the following foreign inquiries: No. 2290.—From a city of southern Europe, correspondence wanted with American firms dealing in metal lathes, scientific instruments, electrical machines and electric railway equipment. No. 2282.—An American consular officer in a city in Germany forwards the names of the principal dealers in paints in his district, with whom he suggests correspondence be taken up by American paint manufacturers. No. 2283.—An American commission merchant would like to act as representative or traveling salesman for American manufacturers. He would make his headquarters in Austria and from there export to the South and the Orient. No. 2292.—An electric lighting company in a South American city is rebuilding its power plant and electric motors will soon be needed in the city. No. 2293.—A Russian firm wants to act as agents for selling American manufactures in Russia and Poland.

TRADE PUBLICATIONS.

Lock Nuts.—A leaflet sent out by Walker Bros. Company, Syracuse, N. Y., illustrates and describes the Victor lock nut. In each leaflet is enclosed a postal, on receipt of which the company will send a sample of the device.

Hart Convertible Cars.—The Rodger Ballast Car Co., Chicago, is distributing blotters, on the glazed sides of which are photographs of wooden and steel underframe Hart convertible cars.

Railway Generators.—Bulletin No. 104 of the Crocker-Wheeler Co., Ampere, N. J., describes d.c. railway generators in sizes from 250 to 650 k.w. The pamphlet is illustrated with photographs of installations at several traction power plants.

Vertical Engines.—Illustrated sectional catalogue No. 232 of the American Blower Co., Detroit, Mich., supersedes catalogue No. 206 on A. B. C. vertical self-oiling engines. The new catalogue contains 64 pages and gives full information concerning this line of small engines, which are made in two types, A and E.

Boilers and Plate Work.—The Traylor Engineering Co., 2 Rector street, New York, has issued a pamphlet illustrating and describing the Hawkes boiler, which is a combination of the horizontal return tubular and the water tube types of boilers. The various products of the company are listed in a table on the last page of the publication.

Union Pacific.—"Homes in the West" is the title of a folder being distributed by the passenger department, telling of free government lands in western Kansas and eastern Colorado on the Union Pacific. Full information is given as to how the land may be acquired and data regarding the agricultural and other resources, rainfall, irrigation, etc.

Chicago & North-Western.—The passenger department has issued its 1908 tourists' guide to the summer resorts and fishing and hunting grounds of northern Illinois, Wisconsin, northern Michigan and Minnesota reached by the North-Western. The information covers the summer train service and gives a complete list of hotels, with location, rates, capacity, etc. There is a small folder giving synopses of the fish and game laws of the states of Illinois, Michigan, Iowa, Nebraska, Wisconsin, Minnesota, South Dakota and Wyoming.

Designing Methods for Reinforced Concrete.—The Expanded Metal & Corrugated Bar Co., St. Louis, Mo., will issue a series of bulletins on designing methods for reinforced concrete construction. The first of these, for May, gives the general principles of design for buildings. Each issue will be devoted to a particular type of structure; the problems relating thereto will be discussed and methods of analysis given, illustrated by a detailed design. The June bulletin will contain a detailed design of a typical building, with a complete analysis of the strength of rectangular and T-shaped beams. A circular accompanying the May bulletin describes the "Economy Unit Frame," for which this company has the selling rights in the United States, Mexico, Cuba and the Hawaiian islands. It is a collapsible frame, easily shipped, placed in the forms as a unit, with the stirrups definitely spaced, and provided with separators to fix and hold the main reinforcing bars in position.

MEETINGS AND ANNOUNCEMENTS.

Engineers Club of Philadelphia.

At a business meeting of this club to be held June 6, a paper on "The Work of Elevating the Philadelphia, Baltimore &

Washington Tracks Through Wilmington, Del.," illustrated by lantern slides, by H. S. Righter, will be presented. Also one on "Waterproofing—An Engineering Problem," illustrated by lantern slides, by Myron H. Lewis.

Association of Railway Claim Agents.

The Association of Railway Claim Agents held its 19th annual meeting in Kansas City, Mo., May 26 and 27. The present membership is about 300, representing 70 of the leading railroads. The attendance at the meeting was 110. The Oregon Railroad & Navigation Co., the Canadian Northern, Northern Pacific and Fort Worth & Denver were admitted to membership. The principal speakers at the meeting were R. C. Richards, General Claim Agent, and F. B. Piersol, Assistant General Claim Agent of the Chicago & North-Western; B. C. Winston, Assistant Attorney, Wabash Railroad; W. E. Jones, General Claim Agent, Missouri Pacific; F. V. Whiting, Chief Claim Agent, Lake Shore & Michigan Southern, and L. L. Losey, Chief Claim Agent, Illinois Central.

The officers for the ensuing year are: President, L. L. Losey (I. C.); First Vice-President, J. G. Trimble (Q. O. & K. C.); Second Vice-President, Parker Dickson (Q. & C.); Third Vice-President, W. G. Bissell (G. N.); Secretary-Treasurer, E. H. Hemus (A., T. & S. F.). The next meeting will be held in Detroit, Mich., in May, 1909.

Western Railway Club.

The annual meeting of the Western Railway Club was held at the Auditorium Hotel, Chicago, on Friday evening, May 29. The reports of the secretary, treasurer and library trustees were read and an election of officers was held for the ensuing year. The secretary reported a total membership of 1,503 and the treasurer's report showed that receipts for the year, including balance on hand January 1, 1908, were $7,020, expenditures were $5,102, leaving a balance of $1,918. The expenses on account of the Barnes library were $825. The larger part of this expense has been for the preparation of an index which is now about completed.

The following officers were elected for the ensuing year: President, M. K. Barnum, Assistant to Vice-President, Chicago, Burlington & Quincy; First Vice-President, W. E. Sharp, Master Car Builder of Armour & Co.; Second Vice-President, J. F. De Voy, Mechanical Engineer Chicago, Milwaukee & St. Paul; Treasurer, P. H. Peck, Master Mechanic Chicago & Western Indiana; Directors, C. B. Young, Mechanical Engineer Chicago, Burlington & Quincy; George H. Bryan, representing Thomas Prosser & Sons, and T. H. Goodnow, Master Car Builder Lake Shore & Michigan Southern. The trustees of the Barnes library, C. A. Seeley, F. W. Sargent and W. F. M. Goss were re-elected. After brief addresses by the new officers, the club was entertained with music by the Illinois quartet and by a vaudeville performance.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Cincinnati, New Orleans & Texas Pacific.—T. C. Powell, Vice-President, has been assigned the duties of the late Vice-President W. J. Murphy. He will have authority over the operating and traffic departments. Fairfax Harrison has been elected a Director, succeeding Mr. Murphy.

Philadelphia & Reading.—Oscar G. Murray, President of the Baltimore & Ohio, has been elected also a Director of the Philadelphia & Reading, succeeding Charles Steele, resigned.

Operating Officers.

Canadian Pacific.—C. Murphy, Superintendent at London, Ont., has been appointed Acting General Superintendent of the Ontario division, with office at London, Ont., James Osborn, General Superintendent, having been granted leave of absence.

Coal & Coke Railway.—A. W. Smith has been appointed General Manager, with office at Elkins, W. Va., succeeding Edwin Bower, Acting General Manager. J. A. Emmart, Acting Assistant General Manager, has been appointed Assistant General Manager, and will continue also as Purchasing Agent, with headquarters at Gassaway, W. Va.

Chicago & North-Western.—John Lepla, Trainmaster at Fremont, Neb., has been appointed Assistant Superintendent of the Black Hills division, with headquarters at Chaldron, Neb. E. O. Mount, Trainmaster at Norfolk, Neb., succeeds Mr. Lepla. E. M. Pangle, Trainmaster at Chaldron, succeeds Mr. Mount.

Delaware & Eastern.—Otto F. Wagenhorst, Superintendent, has been appointed General Superintendent, with office at Margaretville, N. Y., succeeding R. B. Williams, resigned.

Mexican Central.—C. E. Carson, the new Superintendent of Terminals at Tampico, Mex., was born in 1868 at Portsmouth, Ohio, and graduated from Carleton College in 1884. He began railroad work the next year with the Kansas City, Fort Scott & Memphis, now part of the St. Louis & San Francisco, as switchman. The next year he was promoted to assistant yardmaster, and in 1888 was made chief clerk in the Superintendent's office. From 1901 to 1903 he was conductor and general yardmaster. In 1903 he was made chief clerk to the Superintendent of the Terminal Railway Association of St. Louis. On December 1, 1903, he was made Superintendent of the Northern division of the Colorado & Southern, and held this position until his appointment on May 1, 1908, as Superintendent of Terminals of the Mexican Central at Tampico, Mex.

Traffic Officers.

Chicago, Burlington & Quincy.—See Missouri Pacific.

Erie.—A. C. Hilton, General Agent, Passenger Department, at Cincinnati, Ohio, has been appointed General Agent, Passenger Department, at Buffalo, N. Y., succeeding H. E. Huntington, resigned. J. H. Webster, Division Passenger Agent at Elmira, N. Y., succeeds Mr. Hilton.

Lehigh Valley.—A. B. Hill has been appointed General Agent, Passenger Department, at Chicago, succeeding George Eade. deceased.

Maine Central.—Holman D. Waldron, auditor of passenger accounts, has been appointed Assistant General Passenger Agent, with office at Portland, Me.

Missouri Pacific.—H. S. Drysdale, until recently General Agent of the San Pedro, Los Angeles & Salt Lake at Pittsburgh, Pa., has been appointed New England Freight Agent of the Missouri Pacific, the St. Louis, Iron Mountain & Southern, the Denver & Rio Grande and the Texas & Pacific, with office at Boston, Mass., succeeding Henry A. Rich.

C. W. Andrews, until lately Texas Freight and Passenger Agent at Dallas, Tex., of the Chicago, Burlington & Quincy, has been appointed Contracting Freight Agent of the Missouri Pacific, with headquarters at Dallas, Texas.

North & South Despatch.—W. V. Carroll has been appointed General Northern Agent, with office 726 Monadnock building, Chicago, Ill., in place of G. Roy Hall, resigned.

St. Louis Southwestern of Texas.—J. L. West has been appointed Assistant General Freight Agent, with office at Tyler, Tex., succeeding R. C. Fife.

Southern Pacific.—Melville O. Bicknell, the recently appointed Assistant General Freight and Passenger Agent at Tucson, Ariz., was born in 1869 in Vincennes, Ind., and graduated from the high school there in 1887. He began railroad work in the same year as bill clerk with the Evansville & Terre Haute and two years later he was appointed agent of the same road at Patoka, Ind. The next year he was made despatcher at Evansville, Ind. In 1891 he was appointed operator in the joint station of the Southern Pacific and the Atchison, Topeka & Santa Fe at Deming, N. Mex., and the next year was promoted to ticket agent of the Southern Pacific at Deming. In 1895 he was made traveling freight and passenger agent at El Paso, Tex., and three years later became General Freight and Passenger Agent of the Maricopa & Phoenix. In 1902 he was made also Superintendent of this road, and in 1907 was appointed General Freight and Passenger Agent of the Southern Pacific lines in Arizona and Mexico. On April 1 of this year he was

made also Assistant General Freight and Passenger Agent of the Southern Pacific at Tucson, Ariz.

Engineering and Rolling Stock Officers.

Chicago, Rock Island & Pacific.—A. G. Faber has been appointed Signal Engineer, succeeding G. E. Ellis, resigned.

Erie.—O. F. Barnes, Division Engineer of the Rochester division, has been appointed Division Engineer of the Delaware and Jefferson divisions, with office at Susquehanna, Pa., succeeding R. A. Van Houten, resigned. Robert P. Madill succeeds Mr. Barnes, with office at Rochester, N. Y. Harold Knight has been appointed Division Engineer of the Allegheny and Bradford divisions, with office at Salamanca, N. Y., succeeding G. W. Ferguson, resigned to become City Engineer of Paterson, N. J.

Gulf & Ship Island.—N. J. Haynen has been appointed Master Mechanic, with office at Gulfport, Miss., succeeding A. Bardsley, resigned.

Swift Refrigerator Transportation Co.—O. M. Stimson, Master Car Builder, has resigned.

LOCOMOTIVE BUILDING.

The Bolivia Railway is in the market for three locomotives, probably consolidation.

The International & Great Northern is said to be about to order 10 locomotives. This item is not yet confirmed.

The Imperial Taiwan Railway, Japan, has ordered one 3-ft. 6-in. gage mogul tank locomotive from the American Locomotive Co.

The Colorado & Southern has ordered ten consolidation locomotives and three switch engines from the American Locomotive Co. for delivery about August 1. These will be built at the Richmond works.

The Chicago & Alton, as recently mentioned in these columns, has ordered five simple Pacific type locomotives from the Baldwin Locomotive Works for July delivery. The principal specifications will be as follows:

Diameter of drivers	73 in.
Weight, total	243,000 lbs.
" on drivers	155,000 "
Cylinders	23 in. x 28 in.
Boiler, type	Wagon top
" working steam pressure	200 lbs.
" diameter	70 in.
Firebox, length	120 in.
" width	40 "
Tubes, number	367
" diameter	2 in.
Heating surface, tubes	4,000 sq. ft.
" " firebox	197 "
" " total	4,197 "
Grate area	33.65 "
Tender, style	Sloping
" truck	Archbar
Water capacity	8,200 gal.
Coal capacity	13 tons
Special Equipment.	
Boiler steel	Worth
Firebox steel	Worth
Injectors	Hancock
Couplers	Tower

CAR BUILDING.

The Yonkers Railroad is in the market for electric cars.

The White Plains, Tarrytown & Mamaroneck is in the market for 27 electric cars.

The Milwaukee Northern has ordered two special type electric cars from the Niles Car & Manufacturing Co.

The Waterloo, Cedar Falls & Northern has ordered 16 open electric cars from the McGuire-Cummings Manufacturing Co.

The Aurora, Elgin & Chicago is said to be in the market for double trucks for 25 cars. This item is not yet confirmed.

The Wichita Railroad & Light Co. is said to have ordered four double-track open trailer cars for July delivery. This item has not yet been confirmed.

The Dairy Shippers' Despatch, Chicago, has ordered from the Ryan Car Co. the 50 refrigerator cars of 60,000 lbs. capacity for July and August delivery, mentioned in the *Railroad Gazette* of May 24.

The Chicago, Milwaukee & St. Paul is said to be asking prices on four sleeping cars and to be about to build 2,000 additional freight cars for its Pacific extension. This item is not yet confirmed.

The Washington Railway & Electric is said to have ordered 15 interurban cars from the J. G. Brill Co., and it is also said that it will soon be in the market for 30 standard type cars. This item is not yet confirmed.

The Boston & Maine ordered last November 1,000 all-wood drop end gondola cars of 60,000 lbs. capacity from the Laconia Car Co. These are now being built for August delivery. They will measure 34 ft. long, 8 ft. 1 in. wide, and 3 ft. high, inside, and 35 ft. 9 in. long over end sills, 9 ft. 2 in. wide and 7 ft. 2 in. high, over all. The special equipment includes:

Bolsters	Pressed steel
Brake-beams	Buffalo
Brake-shoes	Am. Brake Shoe & Foundry
Brakes	Westinghouse
Couplers	Gould
Draft rigging	Miner tandem
Side bearings	Miner gravity
Trucks	Fox

The Temiskaming & Northern Ontario has ordered two baggage and express and two mail and express cars, weighing 49,000 lbs., from the Preston Car & Coach Co., Ltd., Preston, Can. The inside dimensions of these cars will be 59 ft. 1 in. long, 9 ft. 1 in. wide, and 9 ft. 10 in. high. The over all measurements will be 62 ft. 3 in. long, 10 ft. wide and 14 ft. 3¼ in. high. The special equipment includes:

Bolsters	Diamond
Brake-beams	Simplex
Brakes	Westinghouse
Couplers	Tower
Door fastenings	Dayton and Adams & Westlake
Draft rigging	Miner tandem
Dust guards	Harrison
Journal boxes	McCord
Paint	Pullman (new)
Roofs	Canvas
Side bearings	Susemihl
Springs	Pullman
Trucks	Pullman

IRON AND STEEL.

The Japanese government is said to have been making inquiries in this country for rails to be bought this summer.

The Illinois Central is said to have ordered 52,000 tons of 90-lb. open hearth rails, 42,000 tons of which will be rolled by the Tennessee Coal & Iron Co. and 10,000 tons by the Illinois Steel Co.

RAILROAD STRUCTURES.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Co. is making plans for a complete tie and timber preserving plant to be erected during the coming summer so that by fall it may be put into operation. A. A. Anderson, Seymour, Ind., is General Manager.

HEGEWISCH, ILL.—The Kensington & Eastern, which is a subsidiary of the Illinois Central, has given contracts to James O. Heyworth, Chicago, Ill., for the foundation and masonry work, and to the American Bridge Co., for the superstructure, of the steel and concrete through and deck plate girder bridge, 710 ft. long, to be built here.

HIBBING, MINN.—The Duluth, Missabe & Northern, it is reported, proposes to build extensive yards at Hibbing, including 20 tracks, roundhouse, cinder house and coal docks. It is also stated that a large machine shop is included in the plans.

INDIANAPOLIS, IND.—The Cincinnati, Hamilton & Dayton, it is said, will build a transfer freight depot here.

MONCTON, N. B.—It is expected that the new shops of the Intercolonial being built here to replace those destroyed by fire in 1906 will be completed this fall.

OGDENSBURG, N. Y.—The Rutland Railroad, it is said, has started construction of a $150,000 ferry slip at this place. The slip will be used for the service between Prescott, Ont., and Ogdensburg, N. Y.

PORTAGE LA PRAIRIE, MAN.—Residents of this place are to ask the Railway Commission to order the Grand Trunk, the

Canadian Pacific, the Canadian Northern and the Midland of Manitoba to build an overhead bridge on Campbell street or a subway to replace the present grade crossing.

SCRANTON, PA.—The Delaware, Lackawanna & Western is said to be in the market for 5,000 tons of structural material for its new shops at Scranton.

TORONTO, ONT.—Several contracts were recently given by the Temiskaming & Northern Ontario Railway Commission, which expects to spend $80,000 this year for new buildings and improvements. The contracts will include one for concrete culverts and abutments to Demens & Fraser, New Hamburg; a new freight shed at Haileyburg, to H. C. Dunbar, of that place, and an icehouse at Englehart to R. R. Wood, Latchford.

WINNIPEG, MAN.—A $886,000 contract has been let to Peter Lyall & Son, Montreal, Que., for some of the work on the union station for the Canadian Northern and Grand Trunk Pacific.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALTUS, ROSWELL & EL PASO.—An officer writes that this company was organized to build from Altus, Jackson county, Okla., west via Duke and Hollis, to Memphis, Tex., thence via Silverton, Plainview and Lubbock, to Roswell, N. Mex., thence to El Paso, Tex., 400 miles. Contracts for grading let on first 34 miles from Altus to A. Key, of Hollis, Okla., and to W. Hines and Nels Anderson, of Altus. Additional contracts for track laying, bridges, etc., to be let in 60 days. There is to be a 2,000-ft. trestle over the Salt Fork of Red river, and five small ones aggregating 200 ft. E. Kennedy, President; E. K. Stimson, Chief Engineer, both of Altus. (May 15, p. 686.)

ANGELINA & NECHES RIVER.—An officer writes that this company has 17 miles of track laid on the line it is building from Prosser, Tex., via Manning and Keltys Front, to Platt. Address J. H. Kurth, Keltys, Tex.

CHARLESTON & CASEY (ELECTRIC).—It is reported that the Secretary of State of Illinois has issued a license to incorporate this company, with principal offices at Charleston, Ill. The road is to run from Charleston, Coles county, to Casey, Clark county.

CHICAGO & NORTH-WESTERN.—This company, according to reports, is planning to build an extension from Sioux City, Iowa, northwest to Centerville, S. Dak., about 55 miles. Such a line will give the North-Western a more direct connection with southeastern South Dakota.

According to reports negotiations are pending between this company and the Minneapolis & St. Louis to jointly build a bridge over the Missouri river at Le Beau, the western terminus of the M. & St. L. Surveys are reported being made by the C. & N.-W., from Belle Fourche near the western border of South Dakota, east about 175 miles to the Missouri river, and thence to a connection with its line now in operation to Gettysburg, about 30 miles southeast of Le Beau.

COLORADO, COLUMBUS & MEXICAN.—This company, organized to build from Columbus, N. Mex., on the Mexican border, north to Durango, Colo., about 400 miles, is pushing surveys. The route is through the copper camps of the Burro mountains, N. Mex., the mining camps of the Mogollon mountains, and the coal fields of McKinley and San Juan counties. The line is to be built with 1½ per cent. maximum grade and is eventually to be connected with Salt Lake City, Utah. An extension is projected south to a connection with the Kansas City, Mexico & Orient at Minaca, Mex. The geological reconnoissance is being made by Professor Fayette A. Jones, Albuquerque, N. Mex., who expects to finish the first section this summer. A. O. Bailey, Columbus, N. Mex., is said to be interested.

COLORADO TRANSPORTATION CO.—See Kansas-Colorado.

COPPER RIVER RAILWAY.—An officer writes that this company, heretofore mentioned in these columns as the Copper River & Northwestern, has 20 miles of track laid on the line it is building from Cordova, Alaska, north. Contract let to M. J. Heney, 514 Coleman building, Seattle, Wash., for work on 65 miles. The line is projected north to Bonanza, about 195 miles from Cordova.

ELKINS ELECTRIC.—An officer writes that this company is building, with its own men, an electric line from Elkins, W. Va., via Roaring Creek Junction, Harding, Junior, Belington, Clara, Meadowville, Kalamazoo, Nestorville, Danville, Claud and Knotsville, to Grafton, 43 miles. The maximum grade is to be 1½ per cent.; maximum curvature, 10 degrees. Track has been laid on two miles. J. C. McSpadden, President, Pittsburgh, Pa.; P. B. Bloomfield, Chief Engineer, Elkins.

EL PASO & SOUTHWESTERN.—Plans, it is said, have been made to rebuild that part of this road from Alamogordo, N. Mex., north to Tucumcari. A contract for some of the grading is reported let to Powers & O'Connor.

JOPLIN & EASTERN.—Incorporated with $500,000 capital to build from Joplin, Mo., west to the Kansas state boundary, about 12 miles. Henry Rohwer, E. A. Peters and J. B. Christensen, of St. Louis; R. M. Shepard and E. D. Ninx, of Joplin, are the incorporators.

KANSAS-COLORADO (ELECTRIC).—Incorporated with $5,000,000 capital to build, in conjunction with the Colorado Transportation Co., an electric line from Garden City, Kan., to Canon City, Colo., Colorado Springs and Denver. A. H. Atwater, Canon City; J. A. Lockhart, Rocky Ford; R. W. Patterson, La Junta; A. Russell of Garden City, Kan., and former Governor Alva Adams are among the Directors. The Colorado Transportation Co. is also capitalized at $5,000,000, and has the same directors.

KANSAS SOUTHERN & GULF.—This company, it is said, has arranged for a bond issue, and will start work this summer on an extension from Westmoreland, Kan., southwest to Manhattan, 22 miles. (March 13, p. 391.)

KENTWOOD & EASTERN.—This company has laid seven miles of track between Bolivia, La., and Wilmer, since January 1. George F. Conant, Chief Engineer, Kentwood, La.

KOKOMO, FRANKFORT & TERRE HAUTE TRACTION.—Incorporated in Indiana with $100,000 capital; office at Kokomo, Ind. The company proposes to build an electric line from Kokomo, Ind., west to Burlington, thence southwest via Frankfort and Clinton to Terre Haute, about 110 miles. The directors include W. H. Eikenberry and W. T. Newby, Russiaville; O. Gard and J. T. Kent, Frankfort; M. W. Eikenberry, J. C. Dewees, E. B. Swift and R. H. Ross, Kokomo; A. E. Alter, Forest.

MINNEAPOLIS & ST. LOUIS.—See Chicago & North-Western.

MISSOURI, OKLAHOMA & GULF.—Announcement has, it is said, been made that construction work is to be resumed this month on the extension from Rose, Okla., south through Wapanucka in Johnson county. The extension is projected south to Denison, Tex., about 102 miles. (March 13, p. 392.)

NORTHERN DAKOTA.—Work, it is said, has been started on the proposed line from Edinburg, N. Dak., north to a point near Hallson in Pembina county, thence northwest to the Canadian boundary in Cavalier county, about 21 miles. (April 3, p. 493.)

PHILADELPHIA TERMINAL TRANSFER.—An officer writes that the route of this proposed line is from the Schuylkill river between Manayunk and Norristown, south to a point on the Delaware river water front adjacent to Philadelphia at Fort Mifflin, about 14½ miles. E. B. Colket, President, and H. A. Farrand, Chief Engineer, 618 Mariner & Merchant building, Philadelphia.

SOUTHERN PACIFIC.—This company recently incorporated the Goose Lake & Southern to build 406 miles of road from Goose Lake, Cal., south to Alturas, where the road branches, both divisions continuing in a southwesterly direction to connections with the Southern Pacific at Vina and at Cottonwood. E. C. Calvin, President; William Hood, Chief Engineer, San Francisco.

TWIN CITIES & LAKE SUPERIOR (ELECTRIC).—This company, building a double-track, third-rail line from Minneapolis, Minn., and St. Paul, via Superior, Wis., to Duluth, Minn., 130 miles, has given a contract to Smith & Jones, of Duluth, for work on 30 miles south from the Minnesota-Wisconsin state line near Foxboro, Wis. (March 13, p. 395.)

VIRGINIA & CAROLINA SOUTHERN.—Incorporated in North Carolina with $40,000 capital to build from Lumberton, N. C., where connection is to be made with the Seaboard Air Line and the Raleigh & Charleston, north to Fayetteville, 34 miles. Work has been finished on the first 15 miles from Lumberton to St. Paul, and arrangements are now being made to build 12 miles additional to Hope Mills, where connection is to be made with the Atlantic Coast Line. J. F. L. Armfield, President, Fayetteville, N. C. A. M. McLean, of Lumberton, and John Blue and C. N. Blue, of Aberdeen, are Directors.

WESTERN PACIFIC.—President E. T. Jeffery has, it is said, made a statement concerning progress of construction, as follows: The company has spent over $30,000,000, including terminals, and securing right of way. The necessary terminal lands have, with unimportant exceptions, been secured. Grading has been finished on 600 miles and track laid on about 300 miles. The original plans called for 66 tunnels with a total length of 62,614 ft., but these have been revised so that there will be only 44 tunnels, with a total length of 45,332 ft. About 60 per cent. of this tunnel work has been finished. The company expect to open 360 miles for traffic this summer, and the entire line, 929 miles, early in 1909. (March 13, p. 395.)

YANKTON SOUTHERN.—Surveys, it is said, have been made from Wichita, Kan., south to a point beyond Bristow, Okla., about 150 miles. The line is projected from Yankton, S. Dak., south to Houston, Tex., about 1,020 miles. Fremont Hill, President, Wichita, Kan.; C. S. Corrigan, Chief Engineer, Galveston, Tex. (Oct. 18, p. 474.)

RAILROAD FINANCIAL NEWS.

BOSTON & MAINE.—See New York, New Haven & Hartford.

CHICAGO, CINCINNATI & LOUISVILLE.—James P. Goodrich, receiver of this road, was authorized on May 25 by the federal court at Indianapolis, Ind., to issue receiver's certificates to the aggregate amount of $1,000,000. The certificates are to be of the denomination of $1,000 each and to bear 6 per cent. interest. The principal must be paid within three years from the date of the certificates, but may be paid on any interest-payment day.

CHICAGO CONSOLIDATED TRACTION.—The interest on $6,750,000 4½ per cent. general mortgage bonds which was due June 1 was not paid. It is said that Henry A. Blair, of Chicago, will form a committee to devise a plan for reorganization.

DETROIT, TOLEDO & IRONTON.—The interest due June 1 on $5,500,000 collateral 3½-year 5 per cent. notes for the Ann Arbor was allowed to go to default. The interest on the $4,253,000 general lien 4 per cent. bonds due June 1 was paid.

MEXICAN CENTRAL RAILWAY.—See National Railways of Mexico.

NEW YORK CITY RAILWAY.—Kountze Brothers, of New York, have prepared a second chart showing the relations between the New York street railways and the Interborough-Metropolitan Co. The principal change in this chart from the first one prepared by them is in the addition of the Third Avenue and lines controlled by it through stock ownership. The Interborough-Metropolitan has a stock interest in the Third Avenue.

The Fulton street line, which ran horse cars across the lower end of Manhattan Island on Fulton street, has been discontinued because it did not pay. This has been described as the only street car line in New York City on which it was never necessary for passengers to stand.

NATIONAL RAILWAYS OF MEXICO.—Speyer & Co.; Kuhn, Loeb & Co.; Hallgarten & Co., and Ladenburg, Thalmann & Co., of New York, are offering $13,750,000 prior lien 4½ per cent. sinking fund redeemable bonds at 94. These bonds form a part of a total authorized issue of $225,000,000. They are prior to an authorized issue of $160,000,000 general mortgage 4 per cent. bonds guaranteed principal and interest by the Mexican government. If the readjustment planned is completed as now proposed these prior lien bonds will become a prior lien on nearly the entire Mexican Central, about 3,428 miles. Chairman Macedo says that $64,000,000 of the prior lien 4½ per cent. bonds and $36,000,000 of the guaranteed general mortgage 4 per cent. bonds in round numbers will be issuable forthwith. This means that the amount of bonds to be issued at this time under the clauses of the two mortgages governing construction, betterments and general purposes is to be held down to small proportions. Under the plan Chairman Macedo's totals of the two bond issues appear to be made up as follows:

	Prior lien.	General mortgage.
For immediate exchange of securities	$44,482,962	$24,583.575
For cash	10,000,000	6,750,000
To the Mexican Government	6,000,000	2,450,000
Totals called for by plan of readjustment	$60,482,962	$33,783,575
For improvements, acquisitions, etc.	3,517,038	2,216,425
Totals for immediate issue	$64,000,000	$36,000,000

A large majority of the securities of the Mexican Central and the National Railroad of Mexico have been deposited under the plan of readjustment, and the readjustment managers have declared this plan operative. (April 10, 1908, page 525.)

NEW YORK, CHICAGO & ST. LOUIS.—N. W. Harris & Co., of New York, and the Harris Trust & Savings Bank of Chicago, are offering $2,000,000 of the outstanding $3,000,000 4 per cent. 25-year debenture bonds of 1906-1931, at 89½, yielding 4.75 per cent.

NEW YORK, NEW HAVEN & HARTFORD.—A bill has been filed in the Massachusetts Senate providing that the New York, New Haven & Hartford keep its Boston & Maine stock until July 1, 1910. The voting privilege of this stock is to be exercised by the railroad committee, which also shall recommend by January 12, 1910, a way of disposing of the stock. (See page 39 of this issue.)

OKLAHOMA CENTRAL.—A press despatch from Paul's Valley, Okla., of May 28, states that a receiver has been appointed for this company, which operates 132 miles of line between Lehigh, Okla., and Chickasha. The company's failure is attributed to radical legislation.

OREGON SHORT LINE.—Arrangements have been made with Kuhn, Loeb & Co. for the extension, at 4 per cent., to July 1, 1933, of the Utah & Northern first mortgage 7 per cent. bonds maturing July 1, 1908. Holders of bonds will receive a cash payment of $25 upon the deposit of their bonds on or before June 12, 1908, with Kuhn, Loeb & Co. Bonds not deposited are to be paid at maturity.

PERE MARQUETTE.—It is said that the city of London, Ont., will receive $16,627 from the Pere Marquette for the use of the London & Port Stanley last year.

VIRGINIA & CAROLINA SOUTHERN.—A mortgage has been filed, securing $2,000,000 5 per cent. 50-year bonds of January 1, 1908-1958. Of these bonds $120,000 have been issued at the rate of $8,000 per mile on the 15 miles of road already completed. (See this company under Railroad Construction.)

WABASH-PITTSBURGH TERMINAL.—F. H. Skelding, President of the First National Bank of Pittsburgh, and Henry W. McMasters, General Superintendent of the Wabash-Pittsburgh Terminal, were appointed receivers on May 29. A first mortgage bond holders' protective committee has been formed consisting of J. W. Wallace, Chairman; Paul Morton, Haley Fiske, Harry Bronner, Myron T. Herrick, Gordon Abbott and George O. Butler. This road has 59.9 miles from Pittsburgh, Pa., to Jewett Junction, Ohio, where it connects with the Wheeling & Lake Erie. The company was formed on May 7, 1904. By an agreement with the Carnegie Steel Co. it was to receive a quarter of the steel company's business, but was unable to handle it because of insufficient cars.

A party consisting of Charles M. Hays, Second Vice-President and General Manager of the Grand Trunk; E. H. Fitzhugh, Third Vice-President; W. G. Brownlee, General Transportation Manager; J. W. Loud, Freight Traffic Manager; Howard G. Kelly, Chief Engineer; W. D. Robb, Superintendent of Motive Power; M. S. Blaiklock, Engineer of Maintenance of Way, and other officers of the Grand Trunk, made an inspection of this property two days before the receivers were appointed.